BETTER FARMING

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By

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THE PREFACE

This book discusses the more important phases of farm activity in the order which should be of greatest interest to a class in agriculture. After learning something of the historical development of the subject, it is important that a class make a study of its own community — in other words, make a survey. A leading educator in the agricultural field once recalled his experiences in teaching a rural school. At a time when he was making a hopeless failure as a teacher, he adopted the plan of getting each boy and girl to write a story about the things in his own home. He did not call it a community survey, but the total of these reports showed what the school district possessed, and where the greatest community interest centered.

At that time rats were a great pest in the district. It became evident that the rats should be counted, but to be counted they must first be caught. A prize was offered to the one who should obtain the largest number of rat tails. As a result the boys and girls hurried home to make war on the rats. The parents also became interested and worked with the children to exterminate the pests. The meanest boy in school naturally won the prize for getting the most tails. It was then necessary for the children to write compositions to tell how they had caught the rats. The fact that the bad boy of the school won the prize entitled him to have his story published in the local paper. But it was so poorly written that the boy was ashamed of it, and so studied hard to acquire better methods of expression. Incidentally, he has become one of the leading newspaper men of America.

This contest was a home project. While the rat project is not usually advisable, every teacher may find that it is

a good plan to start some kind of community project during the early part of the school year.

During September and October the fair season has not entirely passed, and a school exhibit creates local interest. This may be followed by an improvement of the school grounds. The care of farm implements and the care of fences are subjects to be considered just before the beginning of winter. Live stock may be studied with interest and profit at the beginning of a feeding period. The new year involves the starting of farm records and plans for marketing. Spring crops soon attract the attention of farm people, and these may be studied as the season advances. By use of this natural plan of teaching, agriculture will become a vital force for improving the school instead of a subject taught when all other studies have been completed.

The subject of agriculture is so broad that no one person can hope to master the details of all its branches. A worker in field crops, for example, is likely to possess general information regarding only such subjects as poultry, fruit growing, or sheep raising. In order to insure accuracy, specialists in various lines have kindly assisted in the preparation of this book. Acknowledgment and thanks are extended to the following: R. B. Cruickshank (landscape gardening) and Dr. J. I. Falconer (marketing), Ohio State University; D. C. Kennard (poultry), W. F. Rofkar (birds), Dr. Freda Detmers (weeds), C. W. Ellenwood (fruit growing), Dr. John Bushnell and Paul Tilford (potatoes), R. C. Thomas (plant diseases), and Dr. L. L. Huber (insect pests), Ohio Agricultural Experiment Station; Dr. J. B. Rhine (plant nutrition), West Virginia University; W. H. Darst (cotton), North Carolina State College of Agriculture, and D. C. Babcock (honeybees), the A. I. Root Company, Medina, Ohio.

BETTER FARMING

CHAPTER I

PROGRESSIVE AGRICULTURE

> New occasions teach new duties; Time
> makes ancient good uncouth;
> They must upward still, and onward, who
> would keep abreast of Truth.
>
> — LOWELL

Most industries have made progress in accordance with the powers of the men and women who have been responsible for their development and improvement. North America has been changed from an almost unknown wilderness into a vast continent of agriculture and industry, supporting millions of people. Men have used all their ability and resources to provide means of tilling the soil and of manufacturing the products of the farm. Our interest is in those who have made possible this rapid advancement of agriculture. With the old wooden plows and oxen of a century ago could we plow each season the millions of acres now farmed? Could we harvest with the old cradle and scythe the millions of bushels of grain now produced?

In our histories the heroes of the farming world have not been given the prominence accorded the great political leaders. Their lives probably were humble, and they did not desire the fame of statesmen and the glamor surrounding their office. A few men, however, have been outstanding figures in the progress of our broad agricultural industry. Some have been responsible for the invention of labor-saving machinery, some for the improvement of seed, some for the improvement of fruits and vegetables, others for the establishment of marketing centers. Our

live-stock industry is not without great leaders, and the more recent progress in rural education is of inestimable value. Let us consider some of those outstanding men who in one way or another have contributed to our present agricultural advancement.

FARM MACHINERY

Plows lead civilization. The story of Rome begins with a man plowing around seven hills. After that time the city became a great center of civilization. Since those early days, some form of plow has aided the development of new centers and the conquest of new worlds. Civilization has moved westward. John Deere (1804–1886) learned the blacksmith's trade in a Vermont community, where good plows were a necessity. In 1834 he moved to Grand Detour, Illinois, where he established a blacksmith's shop. His business prospered, and he soon saw the possibilities of making plows adapted to prairie soils. He experimented with various plows, making iron landsides and steel shares, with moldboards. Three plows were made in 1838 and seventy-five in 1841. John Deere's object was to make a steel plow that would turn the soil

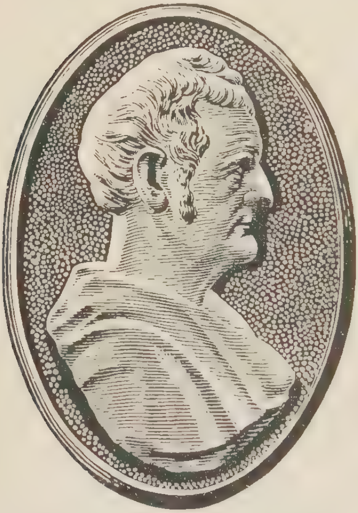

FIG. 1. *John Deere, who invented the steel plow*

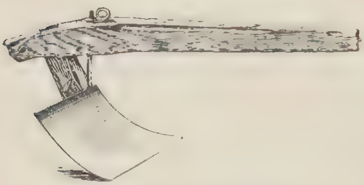

FIG. 2. *Remnant of the first steel plow made by John Deere in 1837*

without requiring too much power to draw the plow. The John Deere Plow Company of Moline, Illinois, was organized to manufacture such a plow. There are now millions of steel plows in use. James, Oliver, Gibbs, and others made plows which have formed the basis for many of our modern plows.

Harvesters. The quantity of grain grown on farms is limited by the harvesting equipment available. The earliest farmers cut the grain with a small hand sickle. It was gathered by other workers and bound into sheaves and shocked. The process was slow and resulted in extensive waste. One farmer could raise enough grain for his family, but he seldom produced more than that quantity. In Europe farms were small and the families were large, the result being a surplus of human labor. During the colonization and settlement of the American continent, conditions were different. Large tracts of fertile soil were available, with very few laborers. As the wheat fields became larger, the demand developed for a machine to take the place of men.

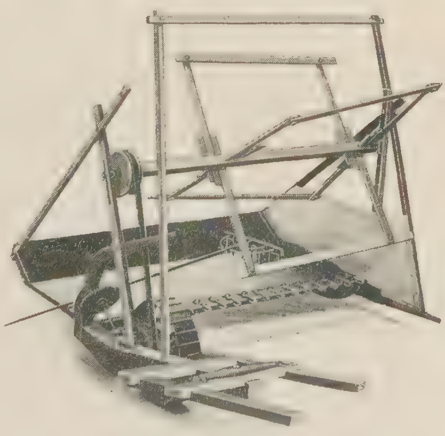

Fig. 3. *A model of the original reaper*

Cyrus Hall McCormick (1809–1884) had the foresight to invent such a machine. His father was a blacksmith in Virginia. In 1831 McCormick made a machine for cutting grain. The more important parts of a modern reaper, including a grain table, reel, and sickle with guards, were used. When the machine was first tried, it

was ridiculed. A patent was obtained in 1834, and improvements have been added since, until we have the modern binders and reapers. McCormick did not succeed in selling his reaper until 1841. Through persistent effort the idea of McCormick has been developed into a great industry.

FIG. 4. *Cyrus Hall McCormick, who invented the reaper*

Millions of bushels of cereals could hardly be harvested by hand labor. Every day in the year reapers are cutting grain in fields in some part of the world.

The threshing machine. A number of men have been associated with the development and improvement of modern grain threshers. The great demand for wheat for bread made the old flail threshers too slow. The first American power thresher was probably patented by the

Pitts Brothers, of Winthrop, Maine, in the year 1837. Their machine worked upon the principle of our modern thresher.

FIG. 5. *An 1831 model reaper at work. Note the rake removing grain from the platform and the binders at work*

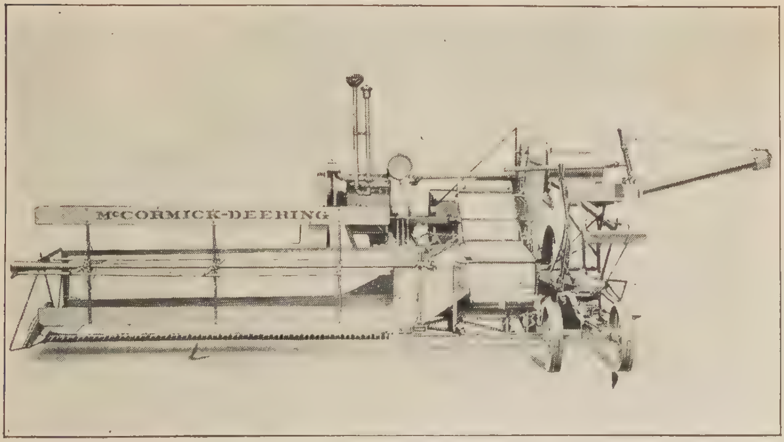

FIG. 6. *A modern combination harvester and thresher. Large quantities of grain may be cut and threshed by a few men at one operation*

The shortage of labor and the large wheat crops of the West have created a demand for a more rapid machine. Curtis C. Baldwin of Kansas invented the combination

thresher. This machine cuts the grain and threshes and sacks it without the waste of time involved in the ordinary cutting, shocking, and threshing.

Engines. According to estimates of the amount of work done by farmers, it has been shown that today a man can do as much work in one hour as a man could do in one day seventy-five years ago. This ability to do more work has been made possible by the remarkable improvement in engines of every sort. The first engines used were steam engines, but the principles of these have been applied to gasoline and kerosene motors, so that now we have a great variety of sources of power.

James Watt (1736–1819) was a Scotch engineer. Most of his education was obtained at his home, near the Clyde River. In 1755 Watt went to London to learn to make mathematical instruments. Later he worked at the University of Glasgow. While repairing a model of Newcomen's engine, he conceived the idea of making a steam engine. A patent was obtained for his steam engine in 1769. After many difficulties of a financial nature, engines were made that would pump water. Further improvements were made. The locomotive and the steamship were invented as a result of steam-engine improvement. Our modern systems of manufacturing, transportation, and farming are largely dependent upon the practical development of steam power.

Gas engines and tractors. Gasoline and kerosene engines work upon the principle of compressing gas, mixed with air, in a cylinder, then exploding the gas by an electric spark from a battery or magneto. This explosion drives a piston which turns the wheels of the engine. This type of engine is known as an internal combustion engine. All our automobiles and tractors are propelled by engines of this kind. A German named Otto improved the internal combustion engine. In 1876 the first one of commercial value was produced.

Tractors have been improved until now we have power units for almost any kind of work, from pulling garden plows to dragging enormous gang plows. Much of the hauling of farm products is now done by motor trucks. They do it more quickly and with less expense than it could be done with horses. Distances of ten or twelve miles for hauling produce were once considered prohibitive, but motors have made even much greater distances seem short.

LIVE STOCK

The mechanical improvements of the past century have been accompanied by corresponding improvements in all kinds of farm animals. One hundred years ago a hog weighing a thousand pounds was probably unknown. A cow producing more than thirty thousand pounds of milk and a hen laying more than three hundred eggs in one year would have been considered impossibilities. Compared with the average of the present day, farm animals of a hundred years ago must have been poor in quality.

How have these great improvements in animals been produced? Demand and necessity induced men to study new types of machinery and to invent new things. The same has been true with live stock, but the methods were different. Living things cannot be changed as machines can be changed. Improvements are made by means of selecting very carefully as parents animals having the desired characteristics, and these characteristics are then likely to be concentrated in the offspring.

Means of improving live stock. Selection of definite types, breeding, and feeding are the essential points in all animal improvement. The needs of the people are always to be considered in making selections and in developing animals. Hogs were grown thirty or forty years ago for the lard produced. Large lean hogs producing pork chops and hams

are now the fashion. The lard hog has disappeared, and butchers demand the streak-of-lean bacon, with very little waste. Other live stock has undergone similar changes to meet popular demand. Horses are larger and faster, cows give more milk, and sheep grow more wool.

Variations are continually occurring, and no two animals are exactly alike. Two pigs in the same litter may be of opposite types. By the selection of big lean pigs for breeding stock, it is possible to produce larger hogs. The change from the small, fat Poland-China to the giant Big Type is a notable example. Animals vary somewhat also with the kinds of feed consumed. Sheep in England still produce different grades of wool as a result of the grass eaten. The limestone hills of the highlands produce fine wool, while the lowlands produce wool of a coarser texture. The blue-grass lands of Kentucky still furnish pasture for the fastest race horses.

Noted individuals. Our horses, cattle, hogs, and sheep have descended from importations from Europe. Many of the greatest sires of European live stock have been purchased by progressive breeders and imported to America. Owing to the wide publicity given famous winners in the show ring, some of these animals may be mentioned with almost as much interest as the men who owned them.

Road and harness horses have been bred to meet the needs of American conditions. Justin Morgan is known as the founder of the Morgan breed. Hambletonian No. 10 was the great sire of the period preceding the use of motor vehicles. Among race horses, Star Pointer, Dan Patch, and Maude S. have occupied important places as American thoroughbreds.

Louis Napoleon was one of the earliest and most noted Percheron horses imported from France. He was brought to Illinois in 1856. Baron's Pride has been considered the greatest Clydesdale sire in the world. Farceur 7332, a great Belgian stallion, sold to a breeder in Iowa for almost $47,000.

Cattle are almost as well known through outstanding individuals as are horses. Whitehall Sultan is known wherever Shorthorn cattle are bred. He has been considered the greatest sire of the breed. The 8th Duchess of Geneva was

FIG. 7. *Carnation King Sylvia, the perfect Holstein which sold for $106,000*

perhaps the highest-priced cow in the early history of the breed, selling for $40,000. Success 2d was a great Hereford, imported by T. L. Miller of Beecher, Illinois. Perfection Fairfax, Prime Lad, Beau Donald, and Repeater are famous leaders of families of Herefords. Blackbird and Pride of

Aberdeen are names of cows from which two great families of the Angus breed originated.

Famous dairy cattle also are interesting. Sophie 19th of Hood Farm was considered the greatest butter producer of the Jersey breed. In seven periods of lactation, she produced 5,280 pounds of butter fat. Sires such as St. Lambert, Oxford Lad, and Raleigh have established much of the quality of the Jersey breed. For milk production, the Holsteins have some outstanding individuals. Tilly Alcartra produced the greatest quantity of milk for a long period. Her record for six years is 156,776 pounds. Carnation King Sylvia, an excellent Holstein sire, was sold to the Carnation Milk Company for $106,000, supposed to be the highest price yet paid for a farm animal.

Noted hogs have not been lacking in the development of American live stock. Liberator, a great Poland-China sire, sold for a reputed $40,000. Kramer's Kind, a Poland-China sow, produced one litter of pigs that sold for more than $17,000. The Duroc breed has some noted individuals, Jackson's Orion King having sold for $31,000. It might be interesting to note that both Daniel Webster and Henry Clay had importations of red hogs from Spain.

PLANT IMPROVEMENT

Grains. Since the beginning of time, man has probably been interested in grain improvement. Grains have been developed from wild grasses and improved by selection and breeding in much the same way as animals have been improved. Indian corn was something new to our ancestors, and genuine improvement of that grain did not begin until the prairies of the Middle West were being settled. Old men can still remember the dwarf flint corn, yielding only a few bushels per acre, very different from our modern yields of seventy-five or one hundred bushels per acre. Reid's

Yellow Dent corn was considered a great improvement over the earlier varieties. The efforts of agricultural experiment stations and of individuals have further improved this corn, as well as other varieties, to meet the needs of the locality in which it is grown.

Wheat and oats have not received the attention necessary for any extensive improvement, but we have had notable increases in yield and quality in these cereals also, especially in the great wheat states of Kansas and North Dakota. State fairs and grain shows of national importance have stimulated individuals to produce grains of remarkable quality. The premiums paid for the best of these exhibits are an encouragement to farmers to try to produce better grain. Yields have been increased by the offering of premiums for the greatest yield from a certain number of acres. The five-acre and ten-acre corn contests are a valuable influence for bringing about the production of more grain on fewer acres. The United States Department of Agriculture has aided greatly in the work of plant improvement by introducing new varieties, by establishing standards for the selection of better seeds, and by crossing superior varieties.

Fruits. The tendency of people to fail to develop their own plants is shown by the story of the Japanese professor who ordered several new varieties of Japanese plums from California, to be planted in Japan. The original plums had been obtained in Japan, taken to California, and carefully improved. They had been growing in Japan for hundreds of years, but the Japanese professor did not know it. Many farmers have the idea that a new kind of fruit, coming from some distant state, will be the wonder of wonders. The fact that it is rare or imported implies that it is something superior. As a matter of fact, some of these rare plants may have originated near our own homes.

Luther Burbank. Luther Burbank (1849–1926) did much to demonstrate the possibilities of those plants growing about us. During a period of fifty years he worked at Santa Rosa, California, developing the best qualities of the plants

FIG. 8. *The favorite photograph of Luther Burbank, the man who made such excellent uses of the plants about him*

about him. He found that several different kinds of potatoes could be selected from the tubers produced by planting the seeds of one potato. One variety was especially good, and has become famous as the Burbank potato. Burbank's work with fruits has been equally notable. His improvement of berries is an example. Many of the accomplishments of Burbank have been exaggerated by popular writers, but his work has been an inspiration to Americans to improve the plants about them.

The Geneva Experiment Station. Some unusual work in breeding and selecting various kinds of fruits has been done by the Geneva Experiment Station in New York. The apples, grapes, and strawberries of that station have become famous. The conservative policy of this station in trying a new kind of fruit for several years before presenting it to the public is commendable. Other experiment stations are doing much to develop better varieties of fruits and to standardize varieties.

Vegetables. It has not been many years since people raised tomatoes for ornamental purposes only, considering the fruit poisonous. Now few gardens are planted without some tomatoes, and they are considered a necessary article of food. They vary from small yellow berries to the great red "ponderosas." Vegetables have been varied to such an extent that they will grow at nearly all seasons of the year. Lettuce and other vegetables are found on the market the year round. Beans and peas no longer are limited to the month of June. Cabbage has been grown at all times of the year. The frost-proof varieties of the South seem to produce better heads in winter than in summer. The wonders of the vegetable world have been so widely exploited that their variations are better relegated to seed catalogs.

MARKETING

Live stock. After we have produced vast quantities of grain, cattle, and vegetables, our great problem is to distribute these, without too much expense, to people who need them. Farmers have had comparatively little to do with the selling and distribution of their products. As cities have grown, retailers, small dealers, and peddlers have established organizations to handle all kinds of products. Animals were once sold directly to butchers, but transportation by railroad made necessary larger systems

of selling in cities. In 1865 John B. Sherman began the organization of a union stockyard in Chicago. Pens were constructed with unloading places. This small beginning was followed by the construction of large packing plants to prepare the meats for selling to the consumer. The union stockyard system has grown until in Chicago there are marketed thousands of hogs, cattle, and sheep every day. The same is true in most of our larger cities.

Grain markets. Grain marketing involves a different problem from that of perishable foods, such as live stock and vegetables. Grain is produced at only one season of the year, but it may be stored in granaries and marketed at any time. In order to secure an even distribution of grain marketing, boards of trade have been organized. Brokers or commission men agree to pay a certain amount for corn to be delivered in June or in September. The price for each bushel may be far above the present price of corn, or it may be lower. The broker making this agreement expects to be able to buy a supply of corn at a lower price. By buying a little grain every day, he secures a certain quantity of corn to be delivered to him at various times. In the meantime, the millers and users of large quantities of corn are buying from the commission man on what is known as a "cash" grain basis. They do not speculate upon the immediate supply, but pay the broker for taking the risk. Considering the enormous supply of grain handled annually, the Chicago Board of Trade accomplishes this work in a very efficient manner. Grain "futures," as this method of purchasing is called, involve a thorough knowledge of the supplies of and demands for grain. Otherwise, the purchase of grain for a delivery six months in the future would be a decided gamble. The milder term "speculation" is applied because the knowledge of crop conditions eliminates some of the chances. Unfortunately, many men have used their

knowledge to gain unusual profits, to the extent that farmers have made many attempts to gain control of the Board of Trade through coöperative movements. Others have advocated the complete abolishment of grain "futures." For want of a more reliable system, the grain markets of America are still controlled by various boards of trade.

RURAL EDUCATION

The production of foods and their marketing have occupied so much time that we forget that, to succeed in their work, modern farmers must have education and special training. As farms become older, the soil becomes poorer by continual cropping, and the next generation of farmers will find it necessary to build up the fertility of the soil, at the same time producing enough for their support. These increased demands will require a better education for farmers of the future.

The Department of Agriculture. After our national government had taken form and the most necessary offices had been established, it was found that new plants could be introduced from foreign countries and grown to an advantage. The Patent Office at Washington developed a branch for introducing foreign seeds. In 1839 a small appropriation was made for agricultural investigations. The office grew until a separate bureau was organized in 1862. In 1889 the Secretary of Agriculture became a cabinet officer. The department has grown until now it is divided into many bureaus, employing thousands of scientific investigators who make a study of everything connected with plant and animal life.

Agricultural colleges and experiment stations. State governments were being formed along with the national government. The states also began to realize the need of more careful training of farmers and the need for a knowledge of

the kind of farming best suited to their respective localities. Lands were sold to provide money for supporting agricultural schools. Every state now has an agricultural college and an experiment station. These have increased in size and influence until they not only instruct young men, but reach out in various ways into every county and almost to every farm.

Agricultural extension. During the World War there was a greatly increased demand for American food products, and farmers found that they must practice better methods of farming. There was a great financial inducement to grow more grain and more hogs. It was asserted that the Department of Agriculture and the state colleges and agricultural experiment stations had knowledge which would increase production greatly. The problem was to distribute this information among the farmers and to get them to put it into practice. Teachers from the agricultural colleges could reach only a small percentage of the farmers, and they were the more progressive individuals. An extension service was developed which has made use of all the various means of introducing better farming. County agricultural extension workers were employed to go into those counties desiring them. They were employed to teach better farming and to encourage demonstrations that would bring the best farm practices home to every community. At the same time teachers were employed to establish special courses in the larger rural high schools. These are the vocational agriculture classes.

Club work. Agricultural extension had not continued very long when it was found that it was indeed difficult to teach an old dog new tricks. Each farmer had his own way of doing things, and he considered his way good enough for him. He held that new-fangled methods were good enough for the young farmers who would never amount to much

anyway, but the old reliable methods were the only thing for him. The aim of the agricultural extension workers, to bring up the boys and girls in the way they should go, gave rise to modern club work. The plan was to encourage boys and girls to follow a local leader in working out one particular type of project. Feeding pigs to grow the largest

FIG. 9. *A group of farmers who are being addressed by an agricultural extension worker*

hog in the shortest time was the aim of many. The endeavor to produce the highest yield of corn on an acre was profitable to others. Intensive methods involved the best agricultural practices, and we may now point to many of our best farmers as examples of those who got their start in club work. Some of the older farmers probably caught the spirit of the younger generation, so farm products of today far exceed those of the years preceding the war.

We may conclude this chapter by stating that: (1) great improvements in farm machinery resulted from a demand

for cheaper methods of producing crops in the great agricultural districts of America; (2) live-stock improvements came as a result of a great meat demand; (3) plant improvements are the product of a desire for more grain on fewer acres; (4) markets developed to handle the surplus of the farm; (5) agricultural education is the result of a need for better farmers. Our present and future agricultural development seems to depend upon these five things.

QUESTIONS

1. When was the United States Department of Agriculture organized?
2. Name three kinds of modern plows.
3. Why were farmers slow in making use of McCormick's reaper?
4. Name three kinds of tractors used in your community.
5. Who was Whitehall Sultan?
6. What determines the value of high-priced dairy cattle?
7. Mention two things that Luther Burbank did for the improvement of plants.
8. What has your state agricultural experiment station done to improve grains?
9. What is the purpose of having a union stockyard to market cattle and hogs?
10. What does a board of trade have to do with marketing grain?
11. Why should vegetable and fruit markets need to hurry in selling their products?
12. What may be learned about farming from the United States Department of Agriculture, from your state agricultural college, or from your county agricultural agent?
13. What are some necessary conditions for insuring agricultural progress?

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CHAPTER II

LIVING CONDITIONS ON FARMS

EARLY FARM LIFE

Two hundred years ago our great American continent was a vast wilderness with a few European colonists living upon the Atlantic coast. They had come from old countries, looking for greater freedom and larger opportunities. In Virginia the Blue Ridge Mountains presented an almost insurmountable barrier. Alexandria was then upon the western border of civilization. In 1730 the Shenandoah Valley was opened to colonists. Scotch-Irish and German people acquired the land by settling it and by paying for a grant issued by the governor of Virginia. "One Jacob Stover, it is said, secured many acres by giving his cattle human names as settlers; and a young woman, by dressing in various disguises of masculine attire, obtained several large farms."[1]

A hundred years later only small outposts had been established west of the Alleghenies. In 1807 a returned missionary, speaking of his work in Marietta, Ohio, told the students of Princeton University that the Ohio and Mississippi valleys were great stretches of forest land that would never be of great value. He declared that transportation was too slow and that people would never be content to live in such a wilderness. But improved means of transportation, the crowded condition along the Atlantic coast, and the restlessness of the American people caused them to push rapidly into the great West. By 1850 the Mississippi Valley was dotted with towns. States had been organized, and the railroad was rapidly becoming the accepted means

[1] *Old Virginia and Her Neighbours*, by John Fiske.

of transportation. Land was to be had for the asking. Fertile farms were easily available by clearing, draining, and improving. More recent disposal of the public lands had been made through the "homestead" process.

Farming methods. With the early American farmer necessity was the "mother of invention." Factories and stores were not common. The object in farming was to produce enough of everything that the family might need to survive the rigorous climate of the new country. Sheep were raised for wool to make cloth. Cattle were kept for milk, beef, and hides. Farmers raised wheat to take to a neighboring mill to be ground into flour, corn was taken to make meal, and cane made sugar. Sugar camps for making maple sugar also were common. Food and clothing were made on the farm, and the object of the household was to provide an ample supply of everything. More than the satisfaction of the immediate needs was unnecessary, because markets had not yet developed. It would have been a waste of energy to have raised a hundred acres of corn without the other necessities of life. However, as the country became more thickly settled, trading and the exchange of products developed.

Changes in methods. When pioneer farmers lived upon small farms their fields were small. Farming was done with small plows and horses or oxen. Grain was harvested by hand. Two horses or oxen, a wagon, a plow, a harrow, and a few hand tools were considered sufficient equipment for a farm. The settlement of the Mississippi Valley involved other conditions. Farmers found great plains ready for the plow. Droves of horses and cattle ran wild in the country farther west. The question was not that of restricting agriculture to a small farm, but that of expanding to meet the demands of the large ranch and wheat or corn farms.

MODERN HOMES

Modern advantages. A great teacher remarked some time ago that the best part about the "good old days" is the fact that they are gone. What old person has not remarked that things are not what they used to be? "The young people of today are so worthless, and the world is surely going to the dogs," remarks the oldest inhabitant. Whatever the conclusions may be in regard to the exact state of

FIG. 10. *A few good shade trees help to make a farm home comfortable and attractive*

affairs, we should look at the American farm home. Its advantages are not to be ignored. Many of the great men of our nation began life upon a farm. They learned to work and to make use of their abilities. Many noted men recall getting up at five o'clock in the morning, milking a cow and feeding pigs before breakfast. A long day probably followed, with endless toil. At night, sleep was most welcome. Such conditions are not encouraging to the puny or to the shiftless, but it may be remarked that these men would probably not have reached their great positions if they had

not had during early boyhood that training which brings out the best in men.

In addition to this training of the boy, there is an unending joy in the surroundings of a country home. From the opening of the buds in spring to the last snow of winter, there is a fascination in our environment. Who does not enjoy waking on a bright morning in April and hearing a robin chirping in a cherry tree? Who does not get pleasure from going into a field of wheat ready for the harvest? What picture is more beautiful than the purple and gold leaves of an October morning? Even a snowstorm provides a certain fascination when we are sitting by a warm fire.

Good roads. The marvelous increase in the number of paved and improved roads has made life in our leading farming states much more desirable. Every county has paved roads, allowing people to reach the city with very little delay. Children may go to a large central school several miles away and be home almost as early as they were when they walked two miles to the crossroads school of forty years ago. Grain and live stock may be marketed much more quickly than in the old days.

Consolidated schools. The 1925 agricultural census indicates that almost two-thirds of the roads of the United States are considered improved. The improvement in schools has been made possible by motor trucks for transporting boys and girls. Little red schools with one teacher served an excellent purpose in their day. The "three R's" were about all the education considered necessary, and the means of acquiring more did not seem to be within the reach of many people. Standards of living improved with better transportation. The automobile brought a demand for still better roads, and the people learned more about their neighbors in the city. They soon learned that the children in cities had the advantage of better schools,

and they found that several small schools could be united into one large school at a smaller expense than was involved in keeping up all the one-teacher schools. The result has been a rapid growth of consolidated schools. Children are transported to these larger schools in motor trucks quickly

FIG. 11. *A well-arranged and thoroughly modern school building in which agriculture is taught*

and comfortably. Many of our consolidated schools compare favorably with the best city schools.

Telephones and radio. While rural life gives an individual the opportunity of developing personality and independence, communication with others has made possible greater progress. Telephones enable the farmer's wife to learn the business of her neighbors during her leisure moments. Time is saved in transacting necessary business and in getting information. Radio information is even more interesting. Market reports are of value to farmers. They may be obtained as quickly in farm homes as in the cities. The baseball games, grand opera, and the leading sermons are broadcast. Unfortunately, according to the 1925 agricultural census, only about 1 per cent of the farmers have radios,

approximately 280,000 in the United States. But it is only a matter of time until a majority of the farmers will have some sort of radio equipment.

Libraries. There are good libraries in the larger cities of most counties. They are of great value to the people living in the city, but farmers find it difficult to reach them. The demands for other farm equipment often prohibit private investment in good books. Traveling libraries from the large county library have aided many farmers. It is understood that most farmers are too busy during the summer months to read, but there are long periods during the winter when good books and magazines are desirable.

Papers and magazines. If there were not a demand for local newspapers and farm papers, we should not have so many. The weekly edition of the local newspaper contains a sort of summary of neighborhood gossip. Local news and the latest bargains in shoes attract the readers. Market information appeals to those farmers who study the reports, or to those who have something to sell. A broad knowledge of markets and their trend has been the secret of most financial successes among farmers. Political interest attracts most Americans. Farm journals and special breed publications have a remarkable influence upon the development of better live stock. A knowledge of what other people are doing along those special lines causes many men to improve their own methods. From time to time books and pictures which are of special interest to farmers are being published. Their influence can hardly be measured in dollars or in immediate returns. Farmers having these things seem to accomplish more, and their homes are more enjoyable.

Organizations. Farmers have made endless attempts at organizing for social, political, and economic reasons. Many of these attempts have been marked by success. The maintenance of a permanent organization that is truly

national in scope involves as many angles as there are classes of people concerned. Since the population of the United States includes people from many lands, difficulty in maintaining a uniform organization is naturally to be expected.

The need for organization has been felt most by growers of special kinds of crops. By the production of one grade of material in a community, in sufficiently large quantities that it may be sold directly to the manufacturer, the profits to the farmer have been increased. Tobacco growers claim that their coöperative organization has sold 90 per cent of the entire crop. Fruit growers in California are able to sell a vast quantity of fruit through the extension of their markets. It has been estimated that 20 per cent of the cotton crop has been marketed through the organization of cotton growers.

Disadvantages of the farm. What makes the farm boy leave home? During the past ten years there has been a decrease in the farm population and an increase in the cities. There must be some reason for the movement toward cities. It remains to be learned that not all roads are improved. Only a few farms have radios and telephones. Libraries and good reading materials are not available to many people. The various farm organizations reach only about two or three million of our forty or fifty million farm dwellers.

Lack of home conveniences. When we consider that only about one-tenth of our farm homes have modern water supplies and that many boys still have to break the ice from the water bucket before thay can wash their faces in the morning, is it strange that they go to the cities? Those long summer days are not spent by farmers in strolling about watching the grass grow and the flowers bloom. They begin work at four or five in the morning and continue until dark. Great physical endurance is necessary to meet the

demands of farm labor. When a man can earn more money working eight hours in a comfortable building than he can

FIG. 12. *This young man has a brilliant outlook*

earn in sixteen hours in the hot sun, there is little inducement to remain on the farm.

Crop failures. Conservative estimates indicate that the average farmer produces crops for only about twenty-five seasons. If four or five of these seasons represent crop failures, it is evident that farmers must make more money during the twenty seasons of success to survive the periods of loss. Thousands of good farmers have toiled for years on wet or poor farms trying to produce enough to pay taxes and provide the necessities of life. These facts may not interest the boys and girls, but their parents know the difficulties of their work and have an inclination to encourage the young people to leave the farm. It is only natural that conditions will change rapidly when farming shows greater profits.

Home inconveniences. Crop failures and long hours of labor are even more disheartening owing to the lack of the most ordinary comforts in so many farm homes. Boys not only have to break the ice from the water pail, but the pump is often located at some distance from the house, so that very cold weather discourages the use of water. Poor mother often wades through the snow to carry water for washing and cooking.

Heating and lighting. A good wood stove in every room is just as good as any method of heating a house, provided there is some one to supply the wood and keep the stoves well filled. The boy who must cut the wood and build the fires does not appreciate that standard of comfort. When kerosene lamps replaced candles as a means of lighting homes, our grandmothers must have thought that their

FIG. 13. *A reminder of the good old days*

troubles would end. The lamps were an improvement, but few of us have ever enjoyed the odor and smoke of kerosene lamps. Electric lights and power have reached thousands

of farms, but it may be some years before a majority of our homes will be equipped with them.

Lack of companionship. What farm boy has not experienced a feeling of loneliness as he drove a team or a tractor for hours plowing a field? That feeling might not be so noticeable for three or four days, but weeks of continued work in the field cause genuine longing for companionship. For the boy who has great possibilities, these long periods alone are times for creative thinking. They may account

FIG. 14. *A school that was good enough for father*

for the fact that our greatest minds have been developed on the farm. However, in the average boy, his greatest desire is to get away and see real life. He wants the companionship and the excitement of the city. The labor of the city may be hard and disagreeable, but he has other men working at his side. White collars and good clothes appeal to boys. A fifteen-dollar-a-week job in a store seems to represent an ideal existence. Girls have the same dislike for rural life. Cooking three meals a day, washing, ironing, and sweeping occupy much time. Recreation often is limited to a Saturday visit to the country store to buy a

supply of groceries. Every girl likes an endless supply of dresses and clothing. The few articles of homemade clothing do not appeal to her.

What may be done. Unless rural life and farmers are able to make the country more attractive, the young people are going to go to the city as soon as opportunities are offered. The most brilliant and most promising get better educations and leave the farms. Is it any wonder that writers are suggesting that the American mind is degenerating? With our modern means of traveling and of communicating, country life could be made more attractive than city life. It is time for farmers to consider these things seriously and to make rural life attractive.

QUESTIONS

1. How were the first American farms obtained by settlers?
2. Give three reasons for people leaving farms.
3. What are three desirable features of country life?
4. If good roads aid so much in making rural life more desirable, why are only about one-third of the roads paved?
5. What is a consolidated school?
6. How does the telephone differ from the radio?
7. How is money obtained for building libraries?
8. Name three farm papers.
9. What is the largest daily paper in your state?
10. Name two farm organizations of national importance.
11. What is the most desirable water system for a farm home?
12. What kind of heating system may take the place of stoves?
13. Would you rather live in the country or in the city?

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CHAPTER III

A COMMUNITY SURVEY

WHAT WE KNOW ABOUT OUR HOMES

People are naturally more or less interested in the affairs of their neighbors, but most of us have a very limited knowledge of the real business of our community. Do you know how many farms there are in your school district? Do you know how many hogs, cattle, horses, sheep, tractors, and automobiles there are? Every five years an agricultural census is taken. In this way our national government really learns more about our resources than we know ourselves. Would it not be interesting for a class in agriculture to start work by learning a number of things about the farms in the community? This would not involve much work for each student, and the results obtained by the entire class would be interesting. If properly conducted, the work should also be of interest in providing material for other classes, as a source of stories and of problems in arithmetic.

Starting a farm survey. In order to have information that will be uniform for all the farms, let us use the points suggested below and list these facts upon a score card so that the totals for the community may be easily obtained. Such a list should be made for each farm, and every boy should be able to answer all of these questions about his own farm. The adjoining farms are also easily listed.

Location of farm. . . . .
Owner. . . . .
Address. . . . .
Distance to shipping point. . . . .
Condition of roads. . . . .
Distance to schools and churches. . . . .

Telephone. . . . .
Electric lights. . . . .
Total area of farm. . . . .
Acres in crops. . . . .
Acres in woods and pasture. . . . .
Acres in roads, swamps, and waste. . . . .
Hilly or level. . . . .
Richness of soil. . . . .
Drainage. . . . .
Buildings, large or small, good or poor, nearness to roads. .
Orchards. . . . .
Trees. . . . .
Number of horses. . . . .
Number of cattle. . . . .
Number of hogs. . . . .
Number of chickens. . . . .
Water supply. . . . .

The above information can be supplied in a few words, and the facts should be learned for every farm if possible. Children may ask their parents most of these questions.

Mapping the farm. In order to study your farm, it is interesting to draw a map, locating the fields, the orchards, gardens, and buildings. The map drawn below will suggest a simple method of illustrating the layout of the farm.

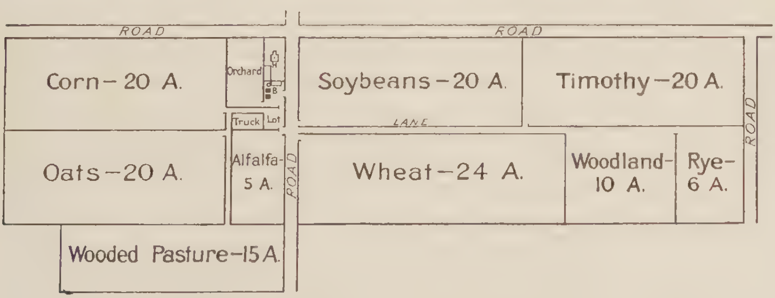

FIG. 15. *Map of farm showing crops grown*

When you are obtaining the information for a farm survey, it might be possible to secure farm record books from

your agricultural college. Place for all the above information has been arranged in the books, with only the blanks left to be completed. A space for the map is provided.

Crops grown. It is also interesting to list the crops grown in the community, to find out the yield and value of each. Suppose George Smith lives upon a farm of one hundred and sixty acres. Eighty acres of corn may be grown upon the farm. It may yield fifty bushels per acre. How much corn is grown upon this farm? It sells at seventy-five cents per bushel. What is the value of the entire crop? If the corn is not sold, George may feed it to hogs and cattle. How much does he feed? Fifty acres of wheat may be grown upon this farm. It yields eighteen bushels per acre. How much wheat does he have? It sells for one dollar and forty cents per bushel. How much money does he make from the wheat and corn? Could he have made more by raising less corn and wheat, pasturing clover and making hay?

John Jones has one hundred and sixty acres of land. He raised thirty acres of corn, yielding eighty bushels per acre. How many bushels does he have from his crop? He raised thirty acres of wheat, yielding thirty bushels per acre. How much money did he have from his entire wheat crop at the price of one dollar and forty cents a bushel? John raises thirty acres of oats each year for feeding. The remainder of his farm is in clover and pasture. He sells five thousand dollars worth of live stock each year from his farm. Who makes more money each year, George or John? Would it not be interesting to follow this same plan for the entire community?

Rotations. Next year John Jones will have clover sod for his cornfield and an entire change of fields for his wheat, oats, and clover. The result will probably be that his yields will increase. George Smith may plant eighty acres of corn

next year, but part of his crop must be grown upon the land which grew corn this year. His wheat stubble field would not be a very fertile land for corn. His yields will probably decrease. If the year is extremely dry, his corn may fail and he is farming at a loss. In the meantime, John is building up his farm, and his income does not depend entirely upon one crop.

Live stock. The 1925 agricultural census contains some interesting information regarding the number of young animals upon farms in the United States. While we have almost as many cattle of all kinds as we had in 1920, there were only about half as many calves under one year of age as there were at that time. This indicates that farmers are not raising many young cattle. The same is true of horses and mules. Such a decrease in young animals means a more limited supply, and those who are raising young stock will profit. Are the farmers in your community raising as many young animals as they did five or ten years ago? If they are not, now is the best time to begin.

Changes in the community. If your community has everything needed for rural happiness, it is not advisable to undertake changes. Unfortunately, there is something wrong with many neighborhoods. The object of the farm survey is to find out whether or not this trouble is due to poor management of the farms. If troubles may be remedied by improving the system of farming, boys and girls should know what to do.

QUESTIONS

1. What are three objects of a community survey?
2. What does the word survey mean?
3. What does the distance from town and from school have to do with the value of a farm?
4. What are three objections to raising only grain upon a farm?
5. What is the advantage of raising clover upon a farm?

6. What is a good crop rotation for your community?

7. Why has the number of young animals decreased during the last few years?

8. Is there any profit in keeping live stock upon farms?

9. How many telephones are there in your school district?

PROJECT LESSON

Exercise I

Object. To make a map of the farms surrounding the school.

Materials. Pencils, large cardboard, and meter or yardsticks.

Procedure. Draw an outline of the four sections (square miles) of farm land nearest your school. Divide these sections into quarter-sections by drawing lines. Continue this division by dividing these into quarters. The smallest squares will then represent forty-acre plots, the next larger squares will be quarter-sections or one hundred and sixty acre lots. First indicate roads by drawing double lines. Then locate streams and bodies of water by drawing lines with blue ink or by shading. Irregular farms may be located very accurately if one knows the number of acres in the farm. The parts of forty-acre portions may be used as a basis for locating the boundary of each farm. If the farms are very small, it may be necessary to visit the office of the county surveyor to get the locations of the farms. The entire class should work at the map, especially in securing information regarding the size of various farms.

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CHAPTER IV

HOME PROJECTS AND CLUBS

THE HOME PROJECT

What is a home project? A good illustration of a home project is one carried out by the writer during his early life upon the farm. When he was eight years old, his grandfather presented him with a runt pig which gave little promise of living through a very cold winter. By the use of warm milk and all other precautions, the pig was ready to eat grass with the other hogs in the spring. The responsibility of the pig's care was placed upon the writer with the understanding that any money that he might get from the sale of the pig should be his own. In August the pig sold for the great sum of eight dollars, quite an amount for an eight-year-old boy in those days. Instead of being allowed to spend the money for the usual foolish things, the writer was encouraged to buy a little red calf. It was indeed an honor to own a calf and feed it along with the other calves. Shelling corn was hard work, especially on cold, frosty mornings, but the calf had to be fed seven days in the week. The next June that calf sold for the enormous sum of twenty-seven dollars, with which a bank account was started. In November that amount was spent for a roan colt. Automobiles were almost unknown in those days, and to own a horse was the greatest ambition of a ten-year-old boy. It is needless to remark that the training and development of that horse were accompanied by many very pointed lessons to the owner, some of them decidedly painful.

In his early experiences with live stock the writer learned a few valuable lessons which still remain. The feeding of

that first pig and of many other pigs caused him to learn the best methods of animal husbandry. It awakened a keen interest in all sorts of domestic animals, an interest which

FIG. 16. *These hogs are part of a herd of unusual hogs which was started as a club project*

has been of great value. The writer still owns a herd of splendid pure-bred hogs and an excellent team of big gray horses.

This was surely an example of a long-continued home project which has contributed much to success in other lines. The writer paid his first college expenses from the sale of farm animals. His father was a country school-teacher, but he applied all of the principles of a teacher of vocational agriculture long before he had begun to talk about clubs and projects. The writer had the pleasure and the inspiration of being allowed to visit one of the first international live-stock expositions at Chicago in a day when schoolboys were not supposed to be interested in such things. The great Shire horses of the king of England and the six-horse teams of those days were really a great inspiration. Thousands of schoolboys now have similar privileges, and they should realize the advantages of seeing the best in the land.

Objects of the home project. The chief purpose of the home project is to give practical training for productive employment. While working with different kinds of crops and live stock, the boy assumes responsibility, develops managerial ability, learns self-denial and thrift, all of which contribute to real citizenship. These qualities make him a leader in the community, instead of a follower. Another great value of project work comes through increased production. If the boys learn how to cull out the boarder cows and the poor hens, and to employ systems of feeding and managing that pay better dividends, they increase farm efficiency.

Essentials of a home project. After selecting a project secure the aid of an agricultural teacher. Then work out and write up a definite plan of your work. A triangular agreement should be made by the pupil, parent, and teacher

FIG. 17. *A successful poultry project under the watchful eye of an enterprising, energetic boy*

in order to insure the coöperation necessary to complete the project. The parent should aid by supporting the work in a financial way. The boy should agree to do the necessary

work and to keep the record. The teacher is the force behind the project. He should be able to create a desire for better things and to inspire the young people to try to do their best.

Poultry projects. Poultry projects are among the most popular. They fit in well with the general home work and afford valuable food in the form of eggs and meat for the

FIG. 18. *A beef cattle project in which ten club boys produced winners over all other clubs in the state of Iowa. Note the uniformity*

table and local markets. The energetic boy or girl may start by buying eggs, baby chicks, or matured fowls. Old sheds or houses may be prepared for protecting them. When the venture has passed the experimental stage, these may be replaced by better buildings. For this work it is suggested that two dozen good hens be bought. Then build them a shelter, feed balanced rations, keep egg records, and market the products.

Crop projects. Corn, potatoes, and gardening are perhaps the most popular projects. Ten-, five-, or one-acre

plots are measured at the beginning of the season and designated as the portion to be estimated for the highest yield. The time and expenses of producing the crop are recorded. These include plowing, planting, cultivating, and harvesting. A sample of the corn or potatoes is often shown at a county fair. The skill necessary for getting the best ten ears of corn or the best peck of potatoes involves some practice. Record writing is not an easy task. Teachers of agriculture have done some remarkable work in teaching boys to do all these things.

CLUBS

Reasons for organization. The old saying, "All work and no play makes Jack a dull boy," applies to farm work especially. We have already mentioned the lack of social advantages in the country. Unless the young people build them up, these advantages will never be there. Agricultural leaders have accomplished much in the farm club work. Almost a million boys and girls belong to these various field, crop, live-stock, and home demonstration clubs. These questions are often asked: "Why do boys and girls join these organizations?" and "What do such organizations mean to the boys and girls?" These questions are answered as follows:

1. Club work is a means of acquiring more education.
2. Club work is a means of earning dollars and cents.
3. Club work increases one's independence by increasing one's wealth.
4. Club work breaks down lonesomeness and isolation by providing a form of organized association.
5. Club work provides an avenue for the development of leadership.
6. Club work stimulates pride in the local community and makes life in the community more attractive.

7. Club work provides for play and recreation. Isolated or individual play is not natural.
8. Club work develops the agricultural and live-stock assets of the community.
9. Club work opens up visions of other things, other places, other institutions, other people.
10. Club work is doing its part right now in providing more and better food and feed at a lower cost.
11. Club work stimulates interest and coöperation among members of the family and the people of the community.
12. Club work makes better home makers and better citizens.

How to organize a club. Whenever there are ten or more club members enrolled in the boys' and girls' demonstration clubs, through the assistance of the county agents or teachers a local club may be organized for the purpose of holding regular meetings and thus encouraging and advancing the value of the work.

A meeting of the enrolled club members should be called by the teacher or county agent, and a constitution similar to that given in this chapter adopted. The next step will be the election of officers. After this, application should be made to the boys and girls' club department of the state agricultural college or of the extension service, using the blank provided by the club department. After the receipt of the charter, the club is fully authorized to proceed with work, as outlined in this chapter.

In counties where there are both men and women agents, it is advisable to form one organization for the boys and girls. This plan is preferred where the local agent thinks it advisable. Where it is found best to form separate organizations for boys and girls, the plans suggested in this chapter may be changed to meet local conditions.

Membership and duties of officers. The membership consists of boys and girls from ten to eighteen years of age who have made out official enrollment cards. Boys must agree to cultivate one acre or more of farm crops or grow live stock according to the instructions of the club leader. Girls must agree to grow a garden, can food, raise chickens, or bake better bread according to the instructions of the club supervisor.

The officers of each local club shall consist of president, vice-president, secretary, and supervisor.

The officers shall be elected to serve one year.

The president or, in his absence, the vice-president shall preside at all meetings and take an active part in the affairs of the club.

The secretary shall keep an accurate record of the business of the club in the secretary's book furnished by the club department. He shall keep the demonstration agents informed as to the progress and conditions of the club work.

The supervisor or assistant supervisor shall have general supervision of the local club and the power of exercising authority in its proper management.

There are no fees or dues to be exacted from the club members, but there shall be no objection to the local club raising money for special purposes.

Each local club shall send one or more representatives to the county club rally or short course, which shall be called by the county agents.

Suggested Constitution

Article 1. Name of Club. This organization shall be known as the ....School Boys and Girls Club.

Article 2. Objects of the Club. The objects of the club shall be to make rural community life more attractive, to encourage interest and coöperation among people in the community, to make farm home life more interesting, and farming more profitable.

Article 3. Membership. Boys and girls from ten to eighteen years of age shall be eligible.

Article 4. Officers. The officers of this club shall be a supervisor, president, vice-president, and secretary.

Article 5. Duties of Members. Prescribed in the rules for contests in each club, such as: Follow instructions, attend club meetings, make exhibits at the school and county fairs, and keep a record of expenses. income, observations, and work.

Article 6. Duties of Officers. The president shall preside at all meetings; the secretary shall keep the minutes and records of all such meetings; the vice-president may act as president in the absence or disability of that officer. The supervisor shall have the general supervision of all local club work, and power of exercising authority in proper management of the club.

Article 7. Advisory Committee. An advisory committee shall arrange for all public contests and exhibits, the procuring and awarding of prizes, and the reporting of statistics and other information to the county agents. This committee shall consist of the county agent, the home demonstration agent if there is one, the county superintendent of schools, and one or two members representing the business interests of the county.

Suggested By-Laws

1. The members of the club shall agree to read all reference literature bearing upon home projects. This may include literature dealing with the growing of corn, grain sorghums, potatoes, poultry, pigs, calves, and breadmaking and canning.

2. A written plan of work must be prepared for the teacher. Members should do all the work connected with the particular contest or project entered upon.

3. The amount of yield by weight, and measurement of land in the crop and canning clubs, and the records of live-stock and poultry clubs must be certified for the contestants by at least two disinterested witnesses, preferably members of the local school board.

4. Every member of the club should make an exhibit at the annual school fair, county fair, or club contest.

5. In order to determine profits, the general expense account for each club activity will be accurately kept.

6. All awards on club work shall be based upon the score cards listed in the club rules.

7. No local organization shall be formed with less than ten members.

8. Upon passing their eighteenth year, club members will be eligible to membership in the local community club.

9. Each member's name should appear upon the program at least once during the year.

Suggestions for holding meetings. Regular meetings may be held once each month. Other meetings may be held as needed.

The secretary shall keep a record of all meetings in the secretary's book which is furnished by the club department.

Those who are to take part in the meetings should have their topics assigned in advance. It may be well to have a program committee.

The members should, when possible, persuade their parents and friends to attend the meetings.

If possible, have a progressive man or woman of the community talk ten minutes to the members at each meeting.

Parliamentary practice. Club members should be familiarized with the following suggestions:

1. Always address the president as Mr. or Madam President.

2. All remarks should be addressed to the president.

3. There should be no talking among members.

4. The president should recognize the person who seeks the floor by saying, "Mr. (or Miss) ———" (person's name).

5. This indicates that the person thus recognized has the privilege of speaking and must not be interrupted.

6. The only interruptions allowable are (1) a call for a point of order, or (2) a question.

7. A point of order applies to a member who has made a motion which is out of order because of another motion before the house, or to a member whose remarks are not on the subject under consideration, or to a person who is exceeding the time limit for discussion.

8. Never offer a motion by saying, "I move you," but simply with "I move."

9. Never offer a motion while another motion is before the meeting.

10. Before any motion is voted upon, the presiding officer must state the motion fully and completely.

11. The ordinary form of voting upon the regular motion is as follows: Presiding Officer: "All favoring this motion will stand" (a short pause to count); "Contrary, stand." The presiding officer then announces the result by saying, "The motion is carried," or "The motion is lost."

Question. A speaker may be interrupted by any member for the purpose of asking a question. His question may be one of personal privilege or may be for the purpose of gaining information about the subject under discussion. The execution of this motion may proceed as follows, member taking the floor while another is speaking:

"Mr. President, I rise to a question of information."

Presiding Officer: "State your question."

12. Motions for privilege of question or point of order take precedence over all other motions.

13. Never attempt to place too many amendments to a motion. It is usually much better to offer a substitute motion.

14. A motion may not be put to a vote of the meeting until it has been seconded or supported by some member other than the one making the motion.

15. In case of a tie vote, the president or presiding officer decides the motion.

16. A motion to adjourn the meeting is in order at any time.

Order of business. President: "We will now proceed with the general order of business."

1. Roll call by the secretary.

(Each member may respond to his name by giving a brief history of his project work since the last meeting.) If the enrollment of the club is large, it is sometimes advisable to have some one member of the club give the report of the entire club.

2. Reading the minutes of previous meeting; also any communications.

3. Receiving applications for membership.

4. Special program for the month may now be given.

5. General business and remarks.

6. Inspection of report books.

7. Reports and suggestions by club supervisor or agent.

8. Ten-minute talk by man or woman living in the community.

QUESTIONS

1. What is a home project?
2. What is the advantage of having just one project instead of several at the same time?
3. What are the ages of club workers?
4. Who should be elected president of a farm club?
5. What should a club supervisor do?
6. Why is a constitution needed for club work?
7. Which project would you prefer?

PROJECT LESSON

Exercise I

Select the home project that appeals to you most. The project should be conducted for six months in the year. Your work should be planned and carried out so as to be credited in your school.

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CHAPTER V

SCHOOL EXHIBITS

Developing interest. If we do not include too much territory, every farm raises the best products in the world. The statement might seem rather absurd, but we have heard dozens of self-satisfied farmers make similar statements. A great surprise is always in store for the farmer who compares his products with those of more distant neighbors. The writer has in mind a very productive corn county, in which the farmers had been raising the same good old variety of corn for years. They had a corn show and found that one farmer was far ahead of all the others in the production of good corn as well as yield. His winning corn was taken to the state corn show with the expectation of surpassing all contestants. To his surprise farmers from other counties outclassed his exhibit to such an extent that he was very much ashamed of it. Instead of going home discouraged, he bought some good seed from the winner and determined to come back the next year with better corn. The enterprising farmer continued to come back until he won the state championship in the corn show. His interest became so great that he encouraged his neighbors to raise the improved corn. They continued to try until that county actually produces the best seed corn in the world. It is sold over the greater part of the United States. Every farmer feels a certain pride in selecting good seed. Increased yields and more money are a natural result.

Securing improvement. In that same county it was found that two or three very progressive seed-corn men had highly developed corn, while many of the poorer farmers did

not use improved seed. Some of them did not want better corn.

The plan developed for improving the seed corn involved the boys who were studying agriculture in the schools. They were interested in learning to select good seed corn. They were shown some of the best corn in the country. A

FIG. 19. *Field selection of seed corn provides material for good samples of corn*

study was made of the size and shape of the ears. The color and firmness of the corn were noted. Then the boys were asked to obtain ten ears as nearly like the ten shown as possible. The work involved a selection of seed from the field during October and November. Fathers were asked about the best kind of corn. Both began to find that few ears of corn were so nearly perfect but that they might find better ones. Their interest became common in the work of the school. The father could hardly afford to allow his son to be ashamed of the corn grown upon his farm, and they

began to work together. The result was a splendid exhibit of corn in the school. The plan reached not only one school, but a dozen schools throughout the county. The

FIG. 20. *Some of the things that help to make a school exhibit of farm products attractive*

improvement has not been limited to corn, but there has also risen in the communities a desire for better schools.

Preparing the exhibit. It is important that all boys and girls in the school prepare something for the school exhibit. There is no fun in having a show in which only four or five are competing. In the fall of the year every farm has something of value. There are apples, potatoes, corn, wheat, vegetables, and eggs that have varying degrees of excellence. The ability to select the best is developed by practice, and every pupil should become observant of these desirable qualities.

A school exhibit does not imply a special showroom with glass cases, blue ribbons, and silver cups for a beginning.

It does not mean that a great portion of the schoolroom should be taken up with tables made for the purpose. Children interested in improving the school may start with a board shelf along the wall on which is displayed a row of ears of corn, apples, and potatoes. The teacher, pupils, and parents should work together to make the school exhibit a success. It should not be the aim of the community to collect all the odd or freakish things, but to collect samples of the best products.

Standard exhibits. State and county fairs have shown that a limited size or quantity of material exhibited is desirable. The following are recognized as standard quantities:

Oats, barley, wheat, rye	1 peck
Edible nuts	1 peck
Potatoes	1 peck or a plate of six
Carrots, turnips, beets, and roots	6 each
Vegetables, fruits, eggplant, peppers, tomatoes	6 each
Vine crops (beans and peas)	1 gallon
Cucumbers	6
Cantaloupe	3
Pumpkins, squash, watermelon	1 each
Sweet corn	12 ears
Onions	1 peck
Pop corn	10 ears
Forage crops	1 bundle or sheaf
Eggs	12
Apples (plate)	6

Corn is perhaps the most commonly exhibited product of the farm. To prepare ten ears of corn representing the best of a variety requires much care and practice. The corn selected for seed from the field should consist of very suitable ears. It is best to collect the seed ears during the months of September and October. These ears will dry until they are firm and well seasoned. Uniformity is the great secret

of success in any exhibit. In corn, this means a collection of ten ears having about the same shape, the same depth of grain, the same size of cob, straight rows of the same size and number on each ear, and freedom from insect injury. By laying out in a row fifty of the best ears you can find, it may be possible to select ten ears of superior quality.

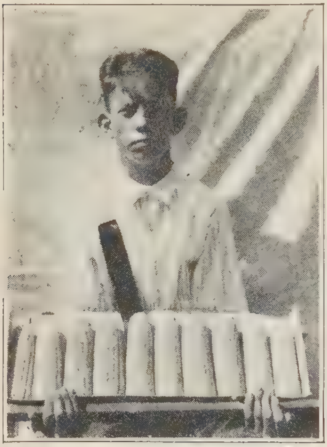


FIG. 21. *This sample of corn represents some hard work on the part of the boy*

FIG. 22. *A suggested means of preparing grasses and grains for display*

Scoring corn. We consider an exhibit of corn desirable when it possesses the following characteristics: The ears should be similar in size, shape, color, and indentation. They should conform to the variety type and be cylindrical, tapering slowly from the butt to the tip. Yellow corn has a red cob, and white corn has a white cob. Crossed or mixed grains are not desirable in white or yellow varieties. The ears are to be firm, ripe, bright, well filled at the tip, and regular at the butt. The grains or kernels should be uniform in size. wedge shaped, with a large germ. The grain when shelled should weigh 85 per cent as much as the weight of the entire ear.

Forage crops. The most difficult to display are forage crops. They should be cut and dried so that the bundles are

bright, of natural color, and uniform. Tying the bundles requires care. The tops, butts, and centers need bands.

Small grains. Small grains are exhibited in paper or cloth bags. A peck of the grain is poured into the bag, and the top is rolled down. It is desirable to have grain of uniform size, and it should weigh heavily. In order to get the grains which weigh most, a larger quantity of seed is taken and thrown across a room. The heaviest grain travels farthest and may be collected for the sample. Head-grain exhibits make a very effective display. From fifty to one hundred heads to the bundle may be tied at the top, bottom, and center. Bright-strawed plants, free from leaves, are desirable.

Eggs. To encourage the production of a better quality of eggs and an interest in the poultry industry, nothing is more valuable than an egg show. Twelve eggs are shown as an entry. They should be as nearly alike as possible. There are white-shelled and brown-shelled eggs. The former are usually from the small breeds of hens, as Leghorns and Minorcas. The brown eggs are from the large general-purpose or meat breeds. A dozen eggs should weigh from twenty-four to twenty-seven ounces. The object is to secure a dozen eggs that are uniform in shape, size, and color.

Scoring eggs. The individual egg should have a shell as nearly perfect as possible. It should be free from lime knots, blotches, checks, air spaces, and other defects which may be seen when the egg is held to the light. Dirty or cracked eggs are undesirable. Washing eggs produces a glossy appearance that is not permitted in an egg show. The yolk should be rich golden in color, without spots except the germ. One great advantage in learning to judge eggs is that of knowing how to grade for the market. Often hens lay eggs of various sorts and shapes. If we should select

the most perfect and uniform, these eggs could be marketed at a much greater profit. The mixing of inferior eggs with the choice ones has a tendency to lower the price of the

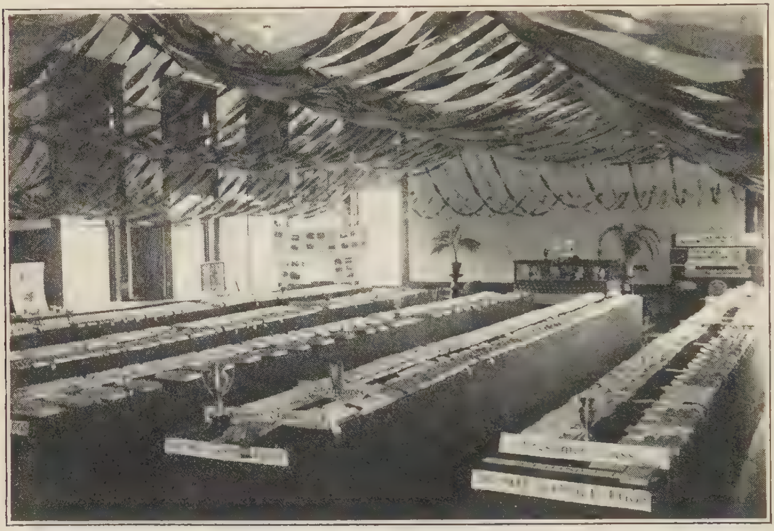


FIG. 23. *A real egg show*

entire lot. White eggs should be marketed as white eggs and brown eggs as brown eggs.

QUESTIONS

1. Why are school exhibits important?
2. How would you make preparations for a school exhibit?
3. Make out a list of the important crops grown in your community.
4. How many ears of corn make a sample?
5. Why is the coöperation of the teacher, pupils, and parents necessary in the building up of a good school exhibit?
6. Tell how to select and arrange forage crops in a school display.
7. Prepare a list of problems likely to be encountered in showing small grains.
8. What is the advantage of showing eggs in a school exhibit?
9. Give the standard weight of commercial eggs per dozen.
10. Discuss the methods of marketing eggs in your community.

PROJECT LESSON

Exercise I

Prepare a school exhibit representing the best that your community can produce.

REFERENCES

Bailey, L. H. *Farm and Garden Rule-Book.* The Macmillan Company, 1914.

Montgomery, E. G. *Productive Farm Crops.* J. B. Lippincott Company, 1918.

CHAPTER VI

LANDSCAPE GARDENING

THE HOME LANDSCAPE

What landscape gardening is. In a brief way, landscape gardening may be defined as the art of making land more useful, more enjoyable, and at the same time more beautiful. To boys and girls, the home and the school are of greatest interest. They offer opportunity for discussing some of the important needs of landscape gardening, and this chapter will confine itself to these. Pupils should be able to add some beauty to their community by improving the appearances of their homes and school.

Just as one may learn to judge the points that go to make good farm crops and animals, so he may learn what constitutes beauty in landscape, whether man-made or nature-made. The mere spending of large sums of money does not guarantee beauty; it may do the opposite. It is quite possible, on the other hand, to create attractiveness about a modest home without much expense, provided the principles of the art are considered.

Divisions of the grounds. The first rules in any landscape improvement plan have to do with the division of the area. A house is divided into rooms. It has a living room, dining room, kitchen, bedrooms, bath, cellar, each one separate from the others and located and designed for its own particular use. Were this not so, there could be no orderliness, no neatness, no effective use, and everything would be in a state of disarrangement. For the same reason, the land about the house should be divided into various parts.

The front lawn. The frame for the picture, the setting for the house, is found in the front lawn. It is more or less

public. These are two reasons, at least, why it should be made as attractive as possible.

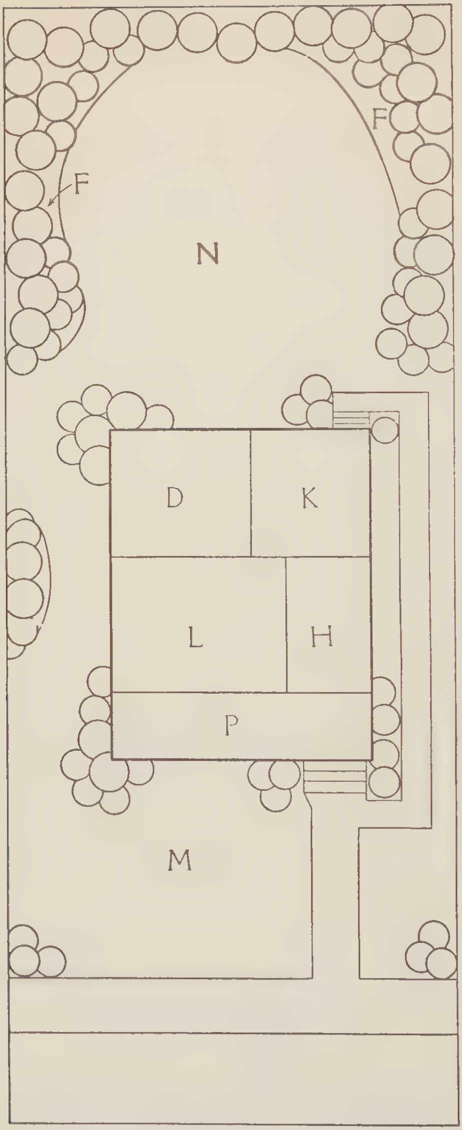
The back yard. The lawn at the side or rear is for private use and is rather secluded. High shrubs, trellises, and fences separate it from other parts of the grounds and neighboring places.

A flower garden. There may be a special plot of ground for the growing of flowers, laid out in a formal way and surrounded by a hedge or wall. It is considered somewhat as an outdoor room and is usually near a living room or porch, so that it may be seen and easily entered from those places. When no special garden is desired, the flowers may be grown in front of shrubbery groups or in the vegetable garden.

The service area. Farm homes need a place where the clothes may be dried, where the wood may be piled, and where the dog may be housed. It is properly known as the service area. The location is near the kitchen, preferably hidden from the public view.

The barnyard. On the farm there is an area associated with the barns, sheds, and live-stock shelters that should be a unit in itself. Unless it is definitely separated from the house by a fence or hedge, the affairs of the barn are almost sure to encroach upon the other grounds about the home. If father and the boys use the back yard for a place to park farm implements and to pasture pigs, mother must hang the clothes in front, and that represents neither efficiency nor beauty.

Drives and walks. The drives and walks are for transportation and should usually be as direct as possible, although, when feasible, curved lines are attractive. The less the drives and walks cut up the lawn spaces, the better, and none except those necessary should be established. Drives are usually located at the back or at the side of the house.



M—Front lawn
N—Back yard
F—Flowers
D—Dining room
K—Kitchen
L—Living room
H—Hall
P—Porch

FIG. 24. *A simple home with well-planned surroundings*

Landscape gardening suggestions. Let us now look at some diagrams to note some different organizations: Figure 24 represents a house on a small town lot. The only areas here are a front lawn (*M*) and a rear yard (*N*). The latter in this case constitutes both a private lawn and a service yard. Shrubs around the borders screen it from without. While there is free passage between the front and back yards, they are practically separate because of the positions of the shrub clumps at the corners of the house. Flowers (*F*) are indicated in front of the shrubs. This is one of the simplest types of arrangement.

Figure 25, page 58, suggests a possible farmstead layout. For the most part, its arrangement is similar to that for city homes. The front and side lawns (*M* and *N*) provide plenty of grass and trees to give a pleasing appearance to the house. The service yard (*S*) is at the rear. The chief distinction is that the house grounds are definitely separated from the barn area (*R*) and from the farm buildings (*F*). The drive (*T*) serves house, barn, and garage. No front walk is shown. Flowers may be grown along with the shrubs or in a garden.

Lawns. Nothing improves the attractiveness of a house more than does a good lawn. This means a clear, smooth turf, frequently cut. If the pupil will compare the appearance of a ragged, unmowed lawn with one recently cut, he will realize that the lawnmower in use is a certain beautifier. Care in trimming the edges along drives, walks, and fences will aid remarkably in maintaining neatness.

The lawn space in front, at the side, or in the rear must be kept open and free from scattered shrubs and disconnected flower beds. Note the difference between *A* and *B* in Figure 30, page 61. The lawn of the house *A* has been broken up by shrubs which have been planted without any particular plan. As a result, it looks small and messy, and

the work in caring for it is greatly increased. In *B* the shrubs have been collected in groups about the foundations of the house, in corners, and along the borders of the property. The latter is preferable. In fact, this principle of the open lawn is one of the most important to remember.

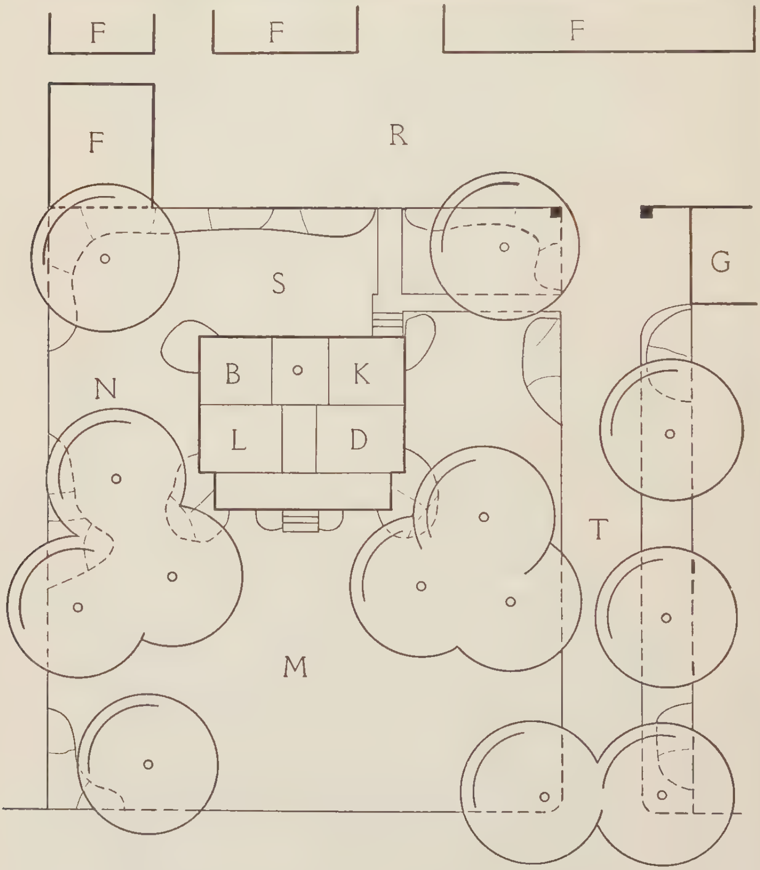


FIG. 25. *A more elaborate arrangement of home grounds*

M —Front lawn
N —Side lawn
S —Service yard
R —Barnyard
T —Drive

F —Farm buildings
B —Bedroom
K —Kitchen
L —Living room
D —Dining room
G —Garage

Ornaments on the lawn. Often there will be seen on lawns such things as old hot-water tanks, sewer pipes, washtubs, and the like, filled with flowers. These are ridiculous, as there can be no possible association between these old affairs and a beautiful landscape. Flower beds surrounded with whitewashed bricks, stones, or bottles are never the

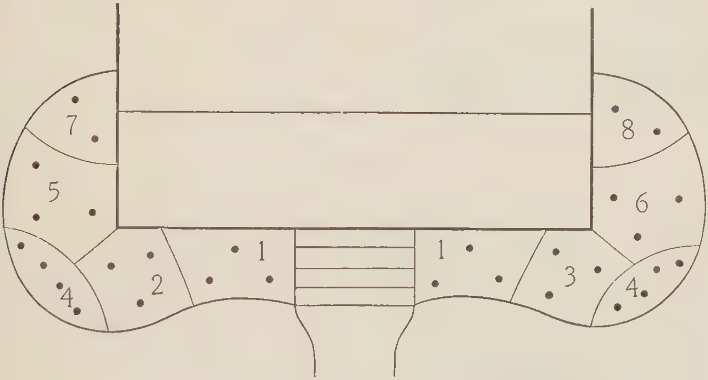


FIG. 26. *Possibilities for a front porch planting*

1. Van Houttei spirea
2, 3. Morrow's bush honeysuckle (*Lonicera morrowi*)
4. Japanese barberry (*Berberis thunbergii*)
5. Tartarian bush honeysuckle (*Lonicera tartarica*)
6. Goldenbell (*Forsythia intermedia*)
7. Lilacs (*Syringa vulgaris*)
8. Mock orange (*Philadelphus coronarius*)

right thing. Iron dogs and sea shells have no place on the lawn. The more natural things are kept, the better.

Seeding the lawn. A good grass-seed mixture is one made of one-half or more of Kentucky blue grass, and the remaining portion a mixture of white clover, red top, and Rhode Island bent. In acid soils, Rhode Island bent and the fescues may be used in larger proportions to substitute for the clover and some of the blue grass. Sow thickly, using at least two pounds to each thousand square feet. Cheap mixtures contain weed seeds and are expensive in the end.

FIG. 27. *An American elm, one of the best trees for landscape purposes. It will grow in most sections of the country*

The addition of nitrogenous fertilizers and bone meal improves the growth of grass.

Trees. Trees are valuable for beauty, shade, and protection from winds. These points should be of help when one is considering where to plant. They are used to frame the house with foliage, to furnish a background, to accentuate desirable views, to hide undesirable ones, to line drives, and to indicate property boundaries. Trees furnish a frame best when planted diagonally off the front corners of the building. A foliage background may be secured by planting trees at any convenient points in the rear of buildings.

FIG. 28. *A simple foundation planting at a farm home*

Kinds of trees. As a general rule, native trees are preferable to unusual ones. Trees that are odd in shape or color, such as Bungei catalpas, camperdown elms, weeping mulberries, and blue spruces, can be used artistically only in special places, and they are not real additions to beauty when set in the middle of the lawn

FIG. 29. *An attractive base planting. If one cannot complete his plan in one season, it is well to begin the work in front of the house*

of a modest home, particularly in the country. The point is that the purpose of planting trees is to add to the attractiveness of the house, and not to call attention to the trees themselves.

Shrubs. Shrubbery in the landscape has many uses. Planted at the foundations of buildings, it serves to break

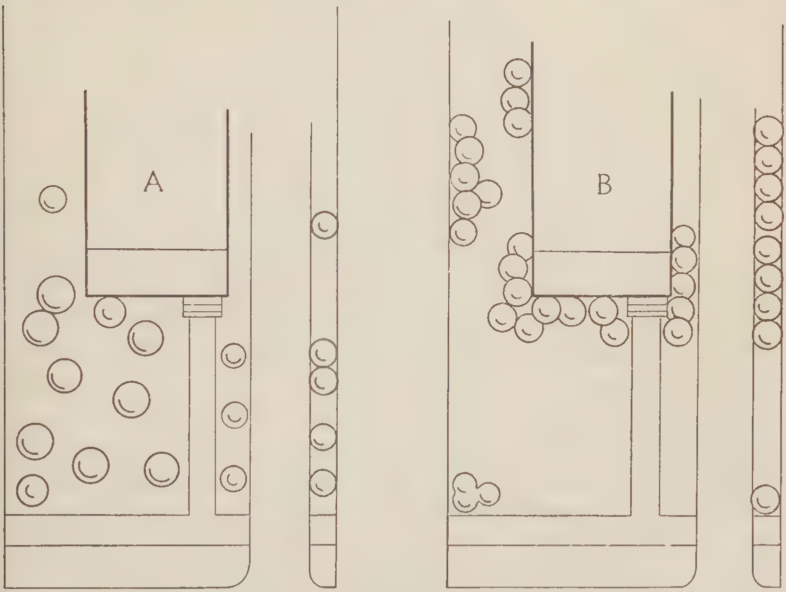


FIG. 30. *Diagrams showing desirable and undesirable plantings*

A indicates trees and shrubbery planted without regard to landscaping
B shows proper grouping

the line between the masonry and the grass and to "tie in" the house to the landscape. Shrubs are employed to flank or inclose lawn areas. They may be used as clipped formal hedges or as mixed borders. Color and variety may be added to the home landscape. The blooms include nearly every color, and they appear throughout the growing season. Winter coloring may be obtained through unusual stems and berries.

Vines. Various kinds of vines are useful when planted at porches, at the walls of buildings, over fences, trellises, pergolas, and summerhouses. They give color, variety, and shade.

Flowers. There are many kinds of flowers which add much to a home landscape in the way of variety and continuity of color. Some flowers live for many years and bloom during a long period each season. Others are planted each year and are useful in filling spaces until the hardier plants are large. As stated earlier, flowers should not be grown in isolated beds in the midst of the lawn.

THE SCHOOL LANDSCAPE

Nothing so surely shows the interest of a community in its education as the presence of a well-built, well-equipped school. Nothing so much improves the appearance of a school building as some well-designed and carefully maintained landscape plantings.

Organization of the grounds. Just as a school building has classrooms, offices, corridors, furnace room, and a gymnasium, so the grounds should be organized for the various uses. There will be a lawn to give an attractive setting, playgrounds for the small children, an athletic field, space for parking automobiles, and drives for school busses. Lawns are usually ruined if the children do not have a regular playground.

Figure 31 suggests a possible rural school ground, from which plans for other schools may be developed. The front lawn is indicated by *B*. At *C* the space may be used for play by the smaller children, the boys on one side, the girls on the other. During social affairs, meetings, and lectures, the area may be utilized for parking purposes. An athletic field is indicated by *D*. If it is large enough, tennis and basketball courts may be built. The drive provides access

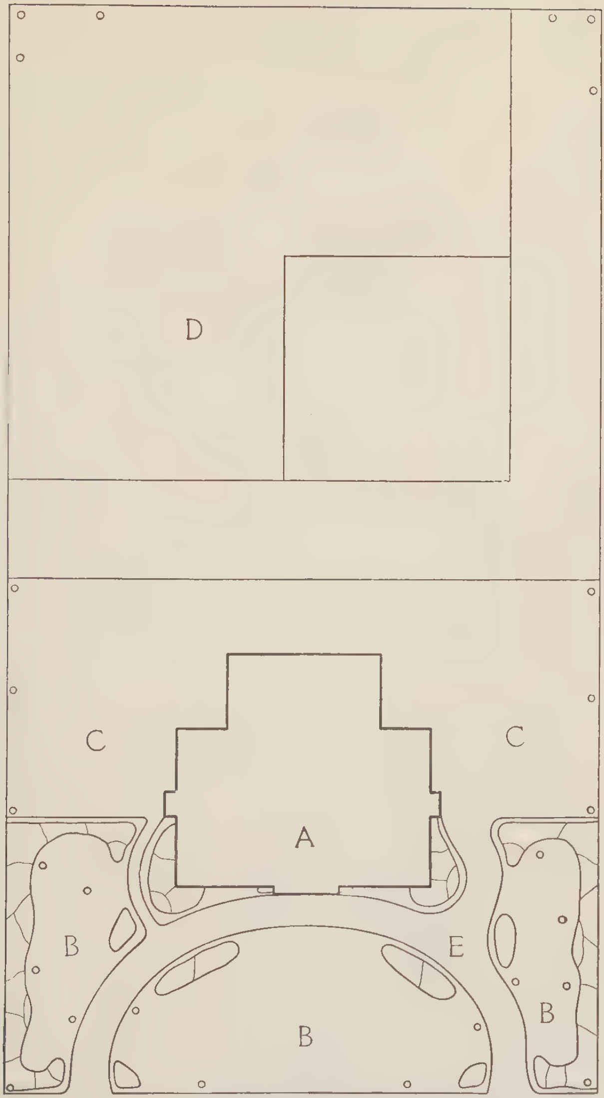


FIG. 31. *Diagram of school grounds showing location of shrubbery and trees*

A —Schoolhouse
B —Front lawn
C —Playground for small children
D —Athletic field
E —Drive
○ —Trees

from two directions to the front entrance, to the side doors, to the parking space, and to the auditorium at the rear.

Shrubbery is planted at the corners of the building, along the flanks of the lawn, at the entrance of the drive, and in bays and angles. Trees, each shown by a o, frame the building without being so near as to cut off the light from the rooms, line the roadway, furnish shade at the edge of the playgrounds, and indicate the far corners of the property.

The same principles that govern the plantings for homes may be applied to schools. In many cases the boys in the school can dig up native trees and transplant them on the school grounds. The shrubbery may be purchased and set out from year to year.

Plant lists. Standard varieties of trees and shrubs for improving landscapes are sold by nurserymen. Some of the better known kinds are listed. The scientific names of most are given, because the common names do not always mean the same in different localities and with different people.

Trees

Ash, American (*Fraxinus americana*)
Catalpa, western (*Catalpa speciosa*)
Catalpa, Bungei
Elm, American (*Ulmus americana*)
Elm, English (*Ulmus campestris*)
Locust, black (*Robinia pseudacacia*)
Locust, honey (*Gleditsia triacanthos*)
Maple, Norway (*Acer platanoides*)
Maple, silver (*Acer dasycarpum*)
Mulberry, Russian (*Morus tartarica*)
Poplar, Carolina (*Populus deltoides*)
Poplar, Lombardy (*Populus nigra-ital.*)
Tree of heaven (*Ailanthus glandulosa*)
Tulip (yellow poplar) (*Liriodendron tulipifera*)
Walnut, black (*Juglans nigra*)
Willow, white (*Salix alba*)
Willow, weeping (*Salix babylonica*)

Shrubs

Almond, flowering
Althea (*Althea frutex*)
Barberry, Japanese (*Berberis thunbergii*)
Bridal wreath (*Spirea van Houttei*)
Dogwood (*Cornus*)
Hawthorne (*Crataegus*)
Hydrangea, American
Honeysuckle (*Lonicera*)
Lilac (*Syringa*)
Privet (*Ligustrum*)
Roses (*Rosa*)
Sumac (*Rhus*)
Viburnum (various species)
Weigelia (various species)

QUESTIONS

1. How does landscape gardening differ from vegetable gardening?
2. What is meant by an area?
3. How may the barnyard be kept separate from the back yard?
4. What are two common mistakes made in planting trees and shrubbery about the home?
5. How should a lawn be prepared?
6. Name seven kinds of trees used for shade in your community.
7. What is the difference between a shrub and a tree?
8. Name four pretty wild flowers that might be grown about your home.
9. How does the arrangement of the school ground differ from that of the home?

PROJECT LESSONS

Exercise I

Object. To draw up a plan for a home landscape.

Materials. Tape measure, pencil, paper, and ruler.

Procedure. Measure the grounds, noting size and shape. Measure the house and other buildings, showing size, shape, and location on the grounds of each. Locate by measurement drives, walks, fences, gates, trees, shrubs, and other features that may influence the plan.

Using a scale of one inch for each ten or twenty feet, transfer accurately to a sheet of drawing paper the measurements taken, so as to have a

complete ground diagram of the grounds and buildings. Indicate the locations in the house of living room, dining room, kitchen, doorway, cellar and first-floor windows. Show positions of doorways in other buildings if any.

Sketch in such changes in the existing features as may be advisable and possible, such as (1) changes in boundary lines, if necessary, to increase or decrease the size of the area, (2) the addition of porches if needed, (3) the removal or relocation of buildings that are undesirably located, (4) relocation of drives and walks, (5) removal of poorly located trees, shrubs, flowerbeds, or ornaments.

In connection with the above points, plan the general organization of the area to provide for (1) a lawn in front, (2) a private lawn at the side or rear, (3) a service area for the house, (4) a utility area in connection with the barns, (5) drive or drives to approach the entrances to the house, garage, and barn.

Decide upon suitable locations for trees, shrubs, and flowers.

Execute the plan or a portion of it.

Exercise II

Object. To draw a plan for the development of the school grounds. This may be a class project.

Materials. Use the same as those in Exercise I.

Procedure. Measure the grounds, showing the size and shape. Measure the school and other buildings, locating them on the area. Locate by measurement drives, walks, fences, trees, shrubs, and other features.

Using a scale of one inch to ten or twenty feet, transfer accurately to a sheet of drawing paper the measurements taken, so as to have a complete ground diagram. Indicate the positions of entrances and windows that are not to be covered by shrubs.

Sketch in such changes as may be desirable for the improvement of the grounds. Decide upon the proper location of trees, flowers, and shrubbery.

CHAPTER VII

CARING FOR FARM EQUIPMENT

The great outdoor tool shed. You cannot always determine the kind of farmer a man is by the appearance of his farm and buildings, but a slovenly farm certainly indicates carelessness and possibly laziness. Every neighborhood has one farm that is very clean and on which everything is put away in its proper place. There are also two or three places in each community where the buildings are needing paint, the implements are standing out exposed to the weather, and the fences are hopeless. What is more deplorable than to see a new plow left in the corner of a field after the plowing for wheat? Did you ever see a binder left in a field in which the farmer had finished cutting his wheat? The weeds probably grew up through it during September. The writer has known farmers to leave mowers in the hayfields until the next year, plowing around them in the spring. Consequently American farmers lose millions of dollars worth of farming implements each year from rust and the lack of suitable protection. Outdoor tool sheds are expensive.

What kind of shed? Before we build an expensive machine shed, let us figure the cost of machinery and how long it should last. Warren, in his *Farm Management*, suggests that an inexpensive shed will do as well as a very expensive one. His reasoning is that the high cost of materials will overbalance any loss from rust or exposure to the weather. But the writer has found that it is very easy to construct a good shed at a very slight expense. From boards that were of little use on the farm, he constructed a large implement shed in woods where four trees formed the posts for supporting the structure. Patent

roofing material covered the shed, and the large doors were swung to the trees at the corners of the building. That shed has been housing farm implements for several years. It is conveniently located, within easy reach of the fields.

FIG. 32. *This is a new hay loader left in the field where the farmer finished cutting his hay last summer. The machine is too expensive to be allowed to rust out of doors*

Repairing. The loss from improper storage is probably equaled by the losses from the lack of oil and repairing. It has been shown that the more complicated machines used upon a farm decrease in value almost one-tenth each year. Under ordinary conditions, a corn or wheat binder will last about ten years. The necessity of replacing it with a new one removes the profit from many acres of wheat. By the application of oil to the parts which move

most rapidly, the length of life of the machine may be increased by two or three years. Tightening the bolts which may have been loosened during the season is important.

When is the best time to do these things? Oiling should be done frequently. Modern implements have well-protected bearings which do not require continuous attention, so that the time for oiling varies with the machine. It is not a difficult task to go over an implement as soon as we have finished using it and tighten any part that may be loose. The vibration and jar of rapidly moving implements will cause the parts to become loose. The tightening of bolts should become a habit with farmers. Tractors are often ruined because of a lack of care in adjusting the parts. An application of axle grease or of old differential grease to plows and disks when they are being stored will save much time that would have to be spent in removing the rust when they are to be used again.

Painting buildings. The painting and repairing of farm buildings may not be entirely justifiable as regards costs. That is, a farmer who never had his buildings painted or the broken windows replaced might become wealthy and live long. But the great majority of farmers take a just pride in having their buildings painted and neat. How long does it require to put the barn door back after an energetic colt has torn it from the hinges? The expense of replacing a broken window is not great.

Learn to do things. Farmers do not need to be skilled carpenters to make many useful articles for the farm. It is very easy to construct a number of small houses and gates during those winter months when the weather does not permit working in the fields. The saving resulting from increased comfort for the young live stock and from increased efficiency will justify one in learning how to do many things.

Hog houses. A brood sow, at farrowing time, needs a house away from the other hogs. Her pigs should not be disturbed, and they need a clean place to start growing into strong, vigorous hogs. An elaborate hog house is not needed. A simple portable house will do very well. The illustration (Fig. 33) suggests a very simple plan of making a portable house large enough for one sow and her family. It does not require a long time to make this portable house, and it will do service for years.

FIG. 33. *A portable hog house. The windows may face north in the summer for ventilation and south in the winter for warmth*

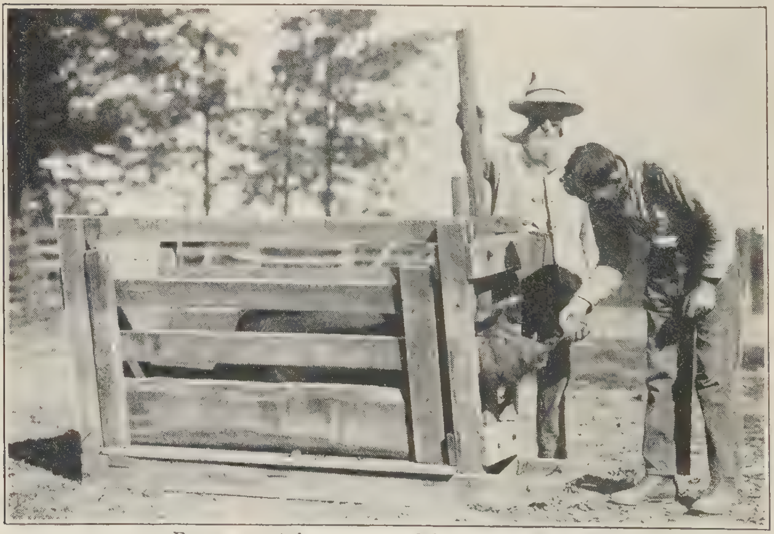


FIG. 34. *A hog crate used for many purposes*

Shipping crates. It is not often that shipping crates are used except in handling breeding stock, but it is well to know how to make them. A simple crate as shown in Figure 34

will do very well. It should be made of strong boards with a substantial bottom. The most common size is 20 inches wide, 3 feet 4 inches high, and 4 feet long.

Feed troughs. There is always a demand for feed troughs where there are pigs or chickens. They should not be of the same size for all kinds of animals. The little pigs and chickens need troughs about 3 or 4 feet long and 2 or 3 inches

FIG. 35. *Well-arranged yards about a barn. Rape pasture will be of value later in the season*

deep, while the older hogs need one 8 feet long and 4 or 5 inches deep. It is well to attach long boards at the ends, to prevent the upsetting of the trough. Braces should be placed across the troughs at intervals of one foot to prevent the hogs from lying in the trough. A cattle-feeding trough is much larger and is placed on posts. Hayracks are very useful in saving hay where a number of cattle and horses are fed.

Yards. Strong fences are needed about barns because farm animals push against these more often than they do against other fences. They should be made of boards or

6

strong woven wire. It is better to have a small lot about the barn, with larger yards for hogs and cattle farther back. Figure 35, page 71, shows a very good arrangement.

Creeps. Little pens for very young stock are called creeps. They are built so that the young animals may have an opportunity to walk into the creep for their feed without being disturbed by the older animals. Young pigs soon learn to crawl into a pen where a bottom board is off to eat from a trough or feeder where the mother cannot crowd them away. Calves will do better if provided with a small pen in which to learn to eat grain. Colts and young mules need a creep so that they may not be fought away by the larger animals.

Poultry houses. The type of poultry house that should be built varies with the needs of the flock, the climate, and

FIG. 36. *An inexpensive poultry house covered with paper*

the resources of the producer. It is not necessary to build an elaborate poultry house to start the raising of good chickens. A large goods box covered with tarred paper is very satisfactory for a beginning with a small number of

hens. In fact, it is not the best plan to build a large house. An 8 by 10 foot house is the most convenient.

Fixtures in the henhouse should be portable so that cleaning may not be difficult. A dropping board, 3 feet wide,

FIG. 37. *A convenient brood coop in which the mother may be placed until the chicks are old enough to care for themselves. They may have protection from rain or from older chickens when they need it*

should be placed 18 inches from the floor at the back of the house. Perches are arranged above the dropping board. Small boxes may be used for nests. These may be placed under the dropping board, so that a clean dark place is available for nesting hens. Portable poultry houses are desirable for large farms.

Brood coops. The hen with a newly hatched family of chicks should have a house and a small plot of lawn where the other poultry may not disturb the chicks. A brooder box 2½ feet square, sloping from 2 feet to 1 foot in height as shown in Figure 37, will serve the purpose. A portable bottom protects the young chicks from cold and moisture.

Uses of concrete. Foundations, floors, borders, walks, posts, water tanks, silos, feeding floors, and roads are being built of concrete. This is almost a concrete age. Various

materials are used for making concrete. Portland cement is the basis of the solidifying element. Sand, gravel, crushed stone, and ballast make up the general body of a concrete structure. These materials are mixed, while the cement is fresh, with water in varying proportions. The mixture is placed in the form or mold before it has time to become set or hard. It is desirable to pack the concrete well into the form, pounding with a tamping stick to make a uniform mass.

The strength of concrete varies with the manner of making the mixture of cement, stone, and water. "Grouting" is the term applied to the coarse concrete used for filling in roads, walks, or floors. A thin mortar made of two parts sand and one part cement, poured over larger rocks and brickbats, makes a good grouting. Foundation concrete is made of gravel, one part; sand, seven parts; and cement, two parts. Walks are made from grouting covered with a fine finish made of one sack of cement to thirty shovels of sand. Concrete posts, tanks, and other structures requiring forms are better if reinforced with iron. Pieces of rods will prevent crumbling. The mixture of concrete is about that used for foundation work, with a little more cement added. It is best to use a large quantity of water in mixing to insure a uniform product. Floors for live stock should not be finished smoothly, because a smooth surface is slippery.

Gates. Our system of farming makes it necessary for every farmer to provide good fences about his farm. He needs gates to pass from his fields to lots and roads. It is annoying to have gates that are sagging or that break every time they are pushed by a horse or a pig. The best gate is made of five strong boards, 10, 12, or 14 feet long, with uprights at each end and a diagonal brace, supported by two short braces. This gate may be hung upon hinges or placed upon a slide.

QUESTIONS

1. Are there evidences in your community of neglected farms?
2. What is the objection to building an expensive implement shed?
3. Which will last longer, a binder which has been oiled or one which has not been oiled? Can you prove your statement?
4. Name several carpentering tools that are useful on the farm.
5. Why should brood sows have individual houses?
6. Give the dimensions of an average shipping crate for hogs.
7. Draw a floor plan of a simple poultry house.
8. Describe a good brood coop.
9. What are some of the uses of concrete on the farm?
10. Explain the term "grouting" as used in concrete making.
11. Describe a good farm gate.

PROJECT LESSONS

Exercise I

Object. To learn to repair and paint.

Materials. One gallon of red wagon paint, a brush, a badly neglected wagon, wrenches, bolts, and wire.

Procedure. Every community has one or more hopeless wagons that might be donated for the use of the class. Broken parts of a wagon may be repaired without much trouble. The bolts may be tightened. When the wagon has been repaired and tightened, it should be washed. After drying, a coat of the red paint will make a great difference in the appearance of the wagon.

Exercise II

Object. To construct a hog crate.

Materials. Large boxes or old boards, saw, hammer, nails, square.

Procedure. Saw boards 20 inches long for the ends and bottom of the crate. Saw corner strips 40 inches long, and sides for the crate 48 inches long. Nail these together. One end should be left for a gate.

Exercise III

Object. To make concrete troughs.

Materials. Shovel, coarse screen, coarse sand, cement, water.

Procedure. After screening the sand, put seven full shovels of the sand into a shallow box. Add one shovel of cement and mix well while dry. Add water and mix until a slushy mud is formed. Pour the mixture into

a mold and allow it to dry. The mold may be made of two boxes shaped like troughs. The result should be a substantial trough. If a finished job is desired, the form may be removed after the concrete has partly dried. An application of watery cement will fill all the small openings and produce a smooth finish.

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CHAPTER VIII

FENCING THE FARM

Why is good fencing necessary? By fencing the farm properly, the farmer is able to keep his poultry, hogs, cattle, and work animals confined in their respective places. His crops are also protected from animals that are running at large. Much time is saved in feeding and caring for live stock by the use of good fences. If every owner keeps his stock at home, he avoids disputes and trouble with his neighbors.

Rail fences and modern fences. Many of the older settlers of our country recall with much joy "the good old days" when farmers felled trees in the virgin forests and, with saw, axe, iron wedge, ring maul, and glut, split rails with which to fence their farms. Timber was plentiful, labor was cheap, and the men were physically fit for the work. The fences were built in wormlike fashion, from eight to ten rails high. These old fences, that were so difficult to build, so wasteful of the land, and so hard to keep, served their purpose. Wire fences have replaced them.

Fencing materials. Posts should be about six or seven feet long for the average farm fence. This will allow them to be set about two or two and one-half feet deep, leaving four and one-half feet above the ground for fastening the fence. White oak, cedar, mulberry, locust, iron, and concrete are the materials most used for posts. Various types of iron and steel posts probably represent the greatest economy, because they last longer and have a neater appearance.

Wire. Barbed wire was quite an improvement over rail fences. It was once considered an extravagance. Owing to the difficulty of building fences of barbed wire, woven

wire has become the most popular kind of fencing material. It is easily stretched and attached to posts, and it will last

FIG. 38. *A rail fence of long standing*

for years. A four-foot fence of No. 9 gauge woven wire is the most desirable. A barbed wire on top of this makes a very durable fence. All kinds of woven wire fencing may be purchased, from a low hog fence to an eight-foot park fence.

Fencing tools. Good fence stretchers for pulling a long stretch of woven wire are not expensive. Every farmer should have one of the clamp and chain devices. Post-hole diggers, an axe, pliers, a hammer, and staples are also necessary. The problem of establishing a fence in a straight line is usually a matter of lining stakes and digging the holes

in line with these. Line posts may be set very easily, but the end posts and corner posts should receive special attention. The life of the fence depends upon these. Embedding in a large concrete base is perhaps the most reliable method of setting end posts.

Temporary fences. While the construction of permanent fences requires extensive preparations, a temporary fence may be established in a very short time. Stakes may be driven with a heavy sledge and woven wire attached in about three trips across a field. The fencing of parts of cornfields is easily accomplished by unrolling woven wire along a row of corn and tying the wire to cornstalks. Animals pastured in such fields seldom try to go through the fence until they have eaten all the corn. Sheep pens are often made by arranging light portable gates about the flock.

FIG. 39. *A very temporary fence*

Hedges. Some farmers have been accustomed to plant hedge fences of various kinds, assuming that they were

ornamental as well as useful. The osage orange or hedge tree made up most of the hedges. When these were closely pruned, they formed a dense mat of thorny growth. The osage orange made an effective hedge, but it had many objectionable features. It required shearing each year to prevent a loose shaggy growth. While the trees live for years, the work of keeping them pruned to the form of a hedge almost equals the expense of building a new fence

FIG. 40. *A substantial corner post with braces*

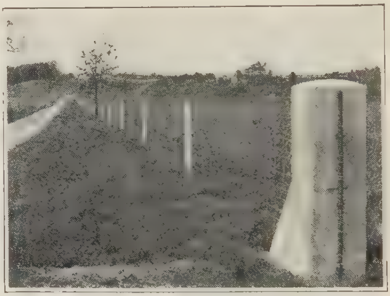

FIG. 41. *A modern fence that will last for years*

each year. The shade is harmful to crops along the fence. These old fences are rapidly being cleared away and replaced by good woven wire fences.

Stone fences. In localities where stone is abundant, stone fences are quite common. The artistic value is their prime virtue, but the fencing of large fields with stone is rather out of the question. Like the ancient rail fences, they provide splendid places for rabbits and other rodents to hide, and an equally interesting place for small boys and dogs to hunt them.

Shapes and sizes of fields. The number of posts and the number of rods of fencing needed to inclose a plot of ground will depend upon the dimensions of the field. For example, to fence a small lot 50 feet wide and 145 feet long, 23½ rods of chicken netting will be required. For a lot 100 feet wide

and the same length as the above, only 29⅔ rods will be required. It may be noted that the more nearly square plot of land will require a smaller amount of fencing in proportion to its area. The following tables give the number of rods of fencing required to inclose fields of different sizes. Some allowance should be made for splicing and fastening the wire round the corner posts:

Number of Acres	Width and Length	Rods of Fence
1	8 rods by 20 rods	56
1	10 rods by 16 rods	52
2	16 rods by 20 rods	72
10	40 rods by 40 rods	160
20	40 rods by 80 rods	240
40	80 rods by 80 rods	320
80	80 rods by 160 rods	480
160	160 rods by 160 rods	640

Summary. The following points should be noted in building fences:

1. Purpose for which the fence will be used.
2. The kind and prices of materials that may be purchased locally.
3. The area and shape of the field to be fenced.
4. Labor available.
5. The kinds of fence used in the community.
6. Is the fence temporary or permanent?
7. The fence row should be clean, the corner posts firmly set and braced, the wire well stretched and stapled.

QUESTIONS

1. Why do farmers need good fences about their farms?
2. Name four kinds of fence that are used on farms.
3. What kinds of material are used for posts?
4. What are the dimensions of a good wooden fence post?
5. Tell how to build a good hog-proof fence.

6. Give the price of woven wire, barbed wire, and fence posts in your locality.

7. How does the shape of a field determine the amount of fencing needed?

8. What is the average height of fences?

9. How far apart should fence posts be set for yard and farm fences?

PROJECT LESSON

Exercise I

Object. To estimate the cost of fencing.

Materials. Pencil and paper, price lists of fencing materials.

Procedure. Estimate the cost of fencing forty acres in your community. The tract is 80 rods long and 80 rods wide. It is to be fenced with woven wire, 4 feet high, with one barbed wire on top of the woven wire. Posts, valued at 40 cents each, are to be placed one rod apart. Twenty corner and end posts are to be placed in addition to the outside fences. Learn from your dealer how much good four-foot No. 9 gauge woven wire costs, and estimate the entire cost. Allowing each man three dollars a day, how much would the labor cost for building the fence?

REFERENCE

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CHAPTER IX

CATTLE

BEEF-PRODUCING ANIMALS

While the numbers of most kinds of live stock have decreased during the last few years, the farm census of 1925 indicates that the number of beef animals has increased since 1920. There must be a reason for such an increase during a period of general deflation and inactivity. It is necessity which has led American farmers to follow the system of farming that would represent the greatest profits. From an agricultural viewpoint, beef cattle should increase in number for several reasons: (1) The handling of beef cattle requires less labor for the returns than other branches of farming; (2) the farmer is able to care for beef animals and do other farming at the same time; (3) the feeding and the care of cattle in winter provide steady employment during an unproductive portion of the year; (4) tracts of land that are unsuited for crop production provide an income as pasture; (5) cattle are needed for maintaining the fertility of the soil; and (6) beef cattle provide a certain quantity of milk for family use in addition to meat production.

What are good beef cattle? The final test of beef production is found when the piece of steak or roast has reached our table. We want something tender, nutritious, and appetizing. Tough, stringy beef is a poor means of securing increased orders. In turn, the butcher wishes to buy live animals that produce a large percentage of these fine juicy steaks and roasts, so that he may have no loss in preparing the meat. Butchers have learned that coarse, rough steers represent as much as half waste, while finer bone, glossy

hair, and soft skin indicate much less waste. The head is of little importance from the butcher's standpoint. Perhaps a medium-sized head is best. The neck should be short and thick. The shoulders should be evenly covered with thick flesh. There should be no depression just back of the shoulders, but the ribs should be well covered. The loin represents the most expensive part of the beef, and it should be thick. The long hind quarters add greatly to the value of the animal as a source of round steak. In general, a beef animal, to be most satisfactory, should have a compact body, rectangular in shape when viewed from the side.

The breeds of beef cattle. Shorthorn, Hereford, Aberdeen-Angus, Galloway, and Red Polled cattle are the recognized American breeds of beef cattle. There are various divisions of the breeds, including the hornless Shorthorns and Herefords. Although there are some very wide differences in the appearance of these breeds, the men who have promoted them have tried to develop those characteristics which insure the best beef at the least expense to the feeder. These attempts have been successful to such an unusual degree that it would be unwise to state that any breed has been shown to be decidedly superior to all other breeds. As the respective breeds are discussed, we may note that there are some qualities making one more desirable for a community than another.

Shorthorns. Northeastern England was the original home of the Shorthorn cattle, probably the county of Durham. Their progenitors were called Longhorns, but the improvement and selection of the short-horned breeding stock caused the change in name. John A. Craig has included in his publication, *Judging Live Stock*, a very good description of Shorthorn cattle. An excerpt from this description is given on page 86.

FIG. 42. *Old Geronimo, twenty-seven years old; all that a beef animal should not be*

FIG. 43. *A desirable beef animal*

The Shorthorn in the course of development has been mainly represented by three family types — the Bates, noted for style, fine heads, clean necks, straight, level backs, refined bone, with a combination of milking and beefing qualities; the Booths, famous for excellence in girth, wide backs, lengthy quarters, deep flesh and beefing attributes; the Cruickshanks, or Scotch cattle, possessed of scale, with low, broad, deep forms, heavy flesh, mossy coats, and early maturity. With this as the source of their evolution, the modern Shorthorn should reflect a blending of the foregoing family types in possessing beef form, early maturity, and all the general evidences of thrift and vigor. . . . . The common colors are red, white, and roan.

In addition to the above characteristics, it might be interesting to learn that they are the largest of the beef breeds. Cows often weigh from 1,200 to 1,600 pounds and the bulls from 1,800 to 2,400. Some of the cows are great

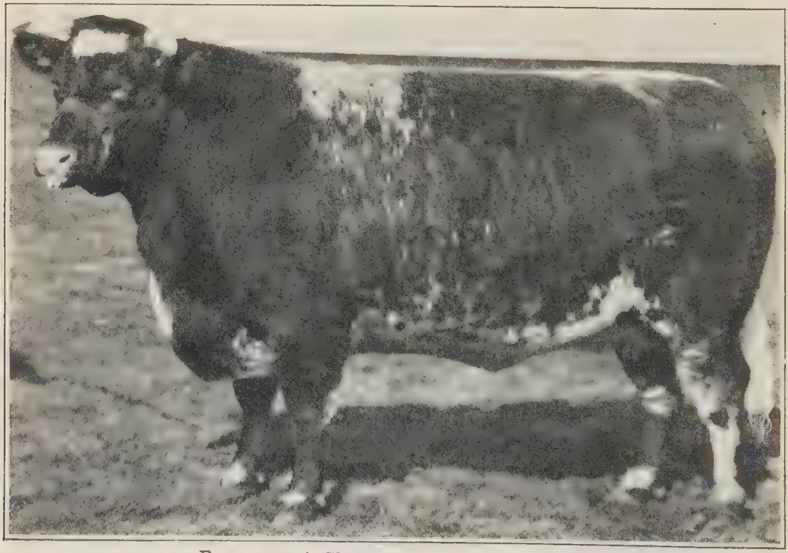


FIG. 44. *A Shorthorn cow, Dorothy Anoka*

milk producers, an Australian-bred cow having held the world's record for some time. She produced more than 32,000 pounds of milk in one year and 1,614 pounds of

butter fat. A strain of these Shorthorns, known as the Milking Shorthorn, has been developed. These cattle are greatly in demand where dairying is as much a business as beef

FIG. 45. *Polled Shorthorn cattle in a woodland pasture*

production. Hornless cattle have appeared among the pure breds, and they are known as Polled Shorthorns, or Polled Durhams. They are sometimes known as "double standard" cattle, because they may be registered either in the Polled Shorthorn Herdbook or in the American Shorthorn Herdbook.

Herefords. The county of Herefordshire in England is the original home of these white-faced cattle. They were first selected for their great vigor and their strength as oxen. The most popular color is dark cherry red with a white face, throat, chest, legs, and twist. Herefords are unusually good beef animals, low set, heavy in the fore quarters, full in the chest, and having a level, wide, thick loin. Well-bred animals have a thick covering of flesh and a glossy, heavy coat of hair. Their ruggedness is so

pronounced that many individuals appear coarse and often lack the smoothness desirable in beef animals of high quality. Early maturity is an outstanding feature. Cattle ranches of the West have a predominance of white-faced cattle. They have unusual vigor and ability to obtain food. Their temperament makes them ideal grazing animals. They do well on short-grass pastures where cattle of other breeds starve. Herefords make rapid gains in the feed lot. Grades and crosses with other breeds are so common that the stock-yards of our leading central markets often have the appearance of being filled with white faces. High prices have been paid for leaders of the breed. Richard Fairfax 449317 sold in 1918 for $50,000. The American Hereford Cattle Breeders Association of Kansas City registers pure-bred animals in the United States. Polled Herefords have

FIG. 46. *A Hereford cow, Joy 4th*

developed from the horned type and are now registered in the Polled Hereford Herdbook. Their popularity is rapidly increasing with the demand for hornless cattle in feed lots.

Aberdeen-Angus. The bleak, chilly hills of northern Scotland are the original home of a remarkable breed of hornless black cattle, known as the Aberdeen-Angus or

FIG. 47. *An Angus cow and calf, Queen Viola K.*

Angus, a name derived from that of the county of Aberdeen and the adjoining country. In fact, the cattle are much more widely known in the United States than is that section of their native land in which they originated. The Scotch called them "doddies," implying a hornless breed. As beef animals, the Angus represent almost an ideal type. Their excellence has been so pronounced that more grand championship premiums have been awarded to Angus cattle than to all other breeds at the International Live Stock Exposition in Chicago. Butchers pay more for black cattle in the central markets.

A very good description of the breed is given by John A. Craig:

The characteristic color of this breed of Scotch cattle is black without any white beyond the udder or above the underline. The type of the breed is favorable to the production of the highest quality of meat in the

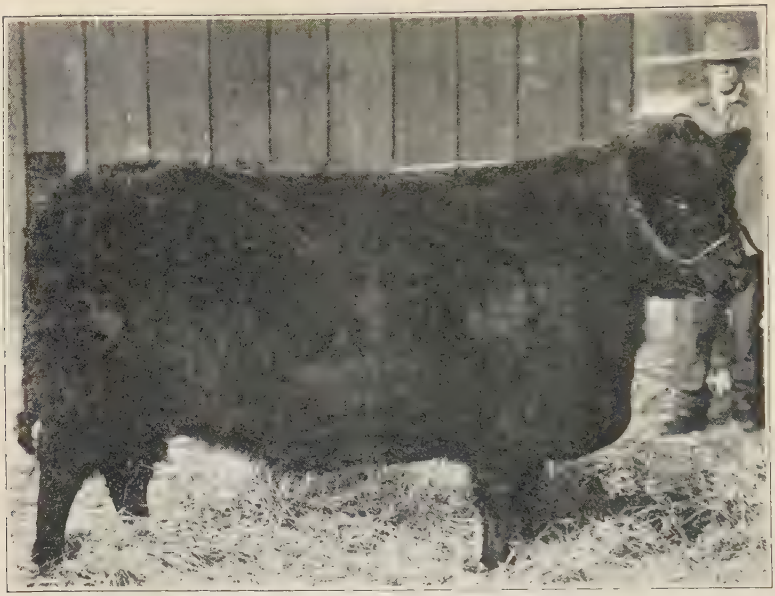


FIG. 48. *A Galloway cow, Carlotta of L. F.*

FIG. 49. *A Red Polled cow, Princess Hassie 2d*

greatest quantity. Smoothness is a leading feature, this being encouraged by the type which is noted for the rotundity of form with symmetry and quality. . . . . The head is hornless without any appearance of scurs, and it should be surmounted by a sharp poll. The ribs are deep and circular, hips moderately wide apart, smoothly covered; rump long, level, smooth; thighs muscular. . . . . The general form is cylindrical, covered with an even depth of mellow flesh and hide that is pliable, yet not thin, and coated with fine, black hair.

Some unusual families of Angus cattle were developed in Scotland. Ericas, Queen Mothers, Pride of Aberdeen, Blackbird, and Blackcaps are the best known. Their descendants represent the greatest proportion of our registered cattle in America. The American Aberdeen-Angus Breeders Association, at Webster City, Iowa, records the names and numbers of pure-bred animals.

Galloways. Southwestern Scotland has another breed of black cattle. They have rather long, curly hair and are hornless. The crest or poll is not pointed as it is in the Angus. White is seldom found above the underline, but the black often has a tendency to brown. Galloways are noted for their hardiness. They are becoming the leading breed of the Northwest because of their ability to survive the very cold winters. The hide of this breed is of considerable value when tanned with the long hair. The American Galloway Cattle Breeders Association registers and promotes the breed in the United States.

Red Polled cattle. A few breeds of cattle have been developed as both beef and dairy animals. The farmers of Norfolk and Suffolk counties in England developed such a breed in the Red Polled cattle. They aimed to secure an easy-keeping, hornless, red-colored, dual-purpose breed. The size of the Red Polled cattle averages less than that of the beef breeds, and the quality of beef is not so good as that of the beef breeds. However, their feeding qualities have made them profitable in the feed lot. The color and

hornless characteristics of the Red Polled cattle are usually predominant over other breeds, so they represent a very desirable type for crossing. In quantity of milk production they probably do not compare with the dairy breeds. Records indicate that three or four hundred pounds of butter fat is an average. The American Red Polled Cattle Club registers and promotes the breed in the United States.

Types of market cattle. The aim of every beef producer should be to supply the demands of buyers with the best

FIG. 50. *A load of prime feeding steers*

grade at the lowest cost of production. In order to know what will bring the highest prices, it is well to learn the kinds of cattle sold in the large central markets. The terms *prime*, *choice*, *good*, *medium*, *fair*, *common*, *plain* are used to classify the kinds of cattle of each grade. *Prime* means that the beef is fattened until all parts of the body are uniformly covered with flesh, that there is very little waste in dressing, that the meat is marbled with fat and lean in the most desirable manner. *Choice* applies to those cattle that are fat and well rounded but which do not have the

dressing qualities of prime cattle. Their fattening has probably been such that they do not have the uniform distribution of fat and lean. *Good*, *medium*, and *fair* apply to those cattle which have been fattened upon grass, or only partially fattened. The result is that the dressed carcass represents only about half the weight of the live animal, whereas the prime cattle dress about two-thirds of the live weight. *Common* and *plain* refer to the poorer grades of animals which have little value for beef purposes. Some of them are returned to lots. *Heavy steers*, those weighing from 1,200 to 1,400 pounds, usually command the highest market prices. *Yearling steers*, those more than one year and under two years of age, weigh from 800 to 1,200 pounds. The quality of the animal determines the price, but prime yearlings often lead the market. *Yearling heifers* are about equal in value to steers. *Butcher cattle* include those which are used for making the by-products of the packing industry, such as canned meats, corned-beef hash, bologna, and mince-meat. Cows and aged animals are included in the group. *Feeders* are the young cattle, too thin to butcher, that are sold to farmers for continued fattening. *Veals* are young calves, weighing under 250 pounds. The term *baby beef* applies to calves under one year of age that have been kept fat, without losing the original milk fat, by the use of liberal quantities of succulent feed. These various grades of cattle are classed as prime, choice, or good, according to their desirability to the butcher.

Baby beef. The safest profits in beef production are usually assured by keeping a few cows and raising calves. These calves should be fed and fattened as baby beef. If such a plan is followed, it is very important to keep a high grade of breeding stock. The cows should represent a desirable beef type, and the sire should be a pure-bred.

With a high-grade calf and well-balanced rations, baby beef production is not so expensive as the feeding of older animals. The calves are ready for the market sooner, and there is no loss of weight at weaning time. Baby beeves are usually

FIG. 51. *A baby beef winner*

allowed to have cow's milk until they are six months of age. In the meantime they are fed ground grain and oil meal. A good cow will often raise two calves.

Feeding suggestions. There have been suggestions for profitable beef production published by the United States Department of Agriculture at various times. These have been summarized as follows:

Good pastures are essential for profitable beef production. Plant pasture grasses over the waste lands.

Use pure-bred bulls for grading up the native stock.

Always select the best heifers for breeding purposes.

Use the coarse fodders, straws, and the stalk fields for wintering the breeding herd.

Wean the calves when the pastures become short. Put them into the cornfields or start them eating ground feed.

Raise and finish beef cattle upon the same farm if possible.

Silage is the best roughage for fattening any class of cattle. More care is necessary in feeding calves than in feeding grown cattle.

It is not entirely satisfactory to use corn stover (fodder) alone as the sole roughage.

Summer feeding on grass is usually more profitable than winter feeding.

Finishing cattle early in the summer is usually more profitable than finishing later in the season.

Fattening steers on grass with grain is nearly always more profitable than grazing them without feed.

Thin steers put on pasture make larger and cheaper daily gains than fleshy ones.

Buying feeders. If conditions are such that it is more profitable to buy feeding cattle than it is to raise them, the farmer usually finds it advisable to go to a large central market where a uniform lot of cattle may be selected. Cattle representing predominantly a beef breed are the best feeders. It is not desirable that they be fat. Fine hair, loose skin, small heads, width between the eyes, short legs, short necks, and well-sprung ribs are desirable characteristics of feeding cattle. Young animals, even if they are very thin, will make rapid and profitable gains if they have not been stunted. The lack of proper food and water causes most of the stunting, which is readily recognizable by rough hair, a hide-bound appearance, and a ewe neck. Such cattle will require a long period of feeding at a small profit.

Methods of feeding cattle. The Corn Belt cattle feeders depend upon corn for most of their fattening. They practice the *dry-lot method* of feeding, providing corn, oilmeal, hay, and silage in such quantities that the animals are

fattened sooner than they are with grass. Dry-lot cattle have a firmer, more uniformly marbled flesh, commanding a higher price than grass-fed beef. This type of feeding is usually completed during the winter months. Farmers often figure that the high price paid for prime beef pays for the extra trouble. Other farmers prefer to "winter" their cattle in the cheapest way possible, by feeding fodder and allowing them to get what they can from pasture. During the spring and summer these cattle are fed grain and fattened on grass. They are sold when very few cattle are being delivered at the central markets. The price is correspondingly high.

DAIRY CATTLE

The appearance of dairy cattle. While the English and Scotch were developing beef cattle, many of their European neighbors were interested in dairy herds. Instead of the fat, short type of cow, the dairy cattle represent lean, muscular, angular animals. The form of the dairy cow is represented by three wedges. From the side, the body is much deeper behind than it is about the chest. From above, the hips are wide and the body tapers toward the withers. The third wedge is from the wide paunch in the center of the body toward the nose. The head of a dairy cow should be lean and neat, without surplus flesh. The body is characterized by a large capacity for feed and ample room for the vital parts. The udder is of prime importance. It should not only have capacity, but it should be well balanced with four uniform teats. Cows producing great quantities of milk usually have large veins extending along the lower parts of their bodies.

The best dairy breed. The kind of cow that you like best is the cow to keep. The liking should be limited to a pure-bred of the standard dairy breeds, preferably one

suited to the farm and facilities for disposing of the products. The sale of whole milk would necessitate cows that produce a large quantity of milk which may be correspondingly low in butter fat. If butter and cream are desired, other breeds would probably be more profitable than those of extremely high milk yields. The breed most common in the neighborhood is probably the most desirable. Not all the people will keep unprofitable cows for an indefinite time. There are many advantages in exchanging animals at various times. It is not only important that pure-bred animals be kept, but their registration and production records are important. Too many farmers keep animals which are "eligible to register," but which are hardly equal to scrubs. Dairymen have eliminated much of this difficulty by selecting young stock to keep by the records of the parents and grandparents.

Jerseys. The native home of the Jersey is the island of Jersey, in the English Channel, where the animals have been improved for more than a hundred and fifty years. A few were imported into the United States from 1840 to 1850 and proved to be very valuable as producers of milk containing a high percentage of butter fat.

In size, the Jerseys are the smallest of all dairy breeds. The calves are small at birth, but grow and mature quickly. The cows weigh from 750 to 1,000 pounds and the bulls from 1,200 to 1,400 pounds when matured. The color may be brown, black, various shades of yellow, fawn, tan, cream, mouse color, or red. In the majority the tongue and switch are black. The cattle have small crumpled horns curved inward, waxy in texture, and often black at the tip. The ideal Jersey is irregular and angular in outline, and the bones are fine and small. The head should be carried erect in walking, and the movement should be light, active, and graceful. The udder is large, extending well forward and

backward. The milk veins should be large and prominent. The teats are of good size, well placed upon the udder. Good cows yield from three to six gallons of milk a day.

Fig. 52. *A Jersey cow*

The cows are docile, but very sensitive. They require good feeding, careful management, and warm quarters.

Holsteins. Holstein cattle have been raised in Holland for many centuries, the breed having been developed in that country and in Schleswig-Holstein. Importations were made into the United States as early as 1850. Because of their great milk production, they have been imported in increasing numbers since that time. Holsteins are the largest of the dairy breeds. Calves are large at birth, weighing from 85 to 100 pounds. They grow rapidly, but do not mature so early as the Jersey. The cows weigh from 1,000 to 1,500 pounds, and the bulls from 1,800 to 3,000 pounds at maturity.

Holsteins are black and white spotted, but the two colors never blend into roans. Breeders generally prefer animals of equal black and white markings. The cows have fine, waxy, tapering horns, narrow at the base, bending forward. Generally, the Holsteins are large, showing great capacity in the body for consuming feed. The head is well proportioned, the neck long and slender, and the back line reasonably level. The hips are broad, and the distance between the pin bones is wide. Good cows yield from four to eight gallons of milk per day. The butter-fat content is low, with small fat globules, producing a light-colored butter when churned. The Holstein cattle have a remarkable capacity

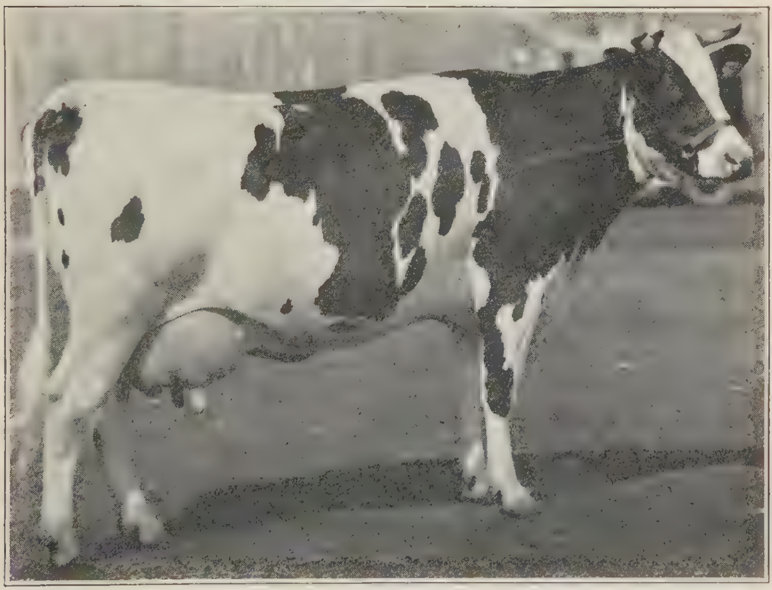


FIG. 53. *A Holstein cow, Princess Alcartra Concordia*

for consuming feed, including roughage of various kinds. They are best suited for dairy work where the bottled milk is sold.

Guernseys. There is not any great difference between Jerseys and Guernseys, the latter coming from the island of Guernsey. The first importations were made into the

FIG. 54. *A Guernsey cow, Margaret of Gayoso*

United States in 1850. The cattle are larger than the Jerseys, but resemble them in general conformation.

The color is yellowish, brownish, or reddish fawn, with white markings in patches on the legs. The parts about the mouth are usually light yellow, and rings about the eye may be of the same color. The horns are small, curved, waxy, and of deep yellow color at the base, whitish at the tip. The udder is large and well developed. The teats are of good size, well shaped, and easily milked. The cows yield about as much milk as do the Jerseys, and they have the added advantage of producing a very yellow milk. Rich, yellow butter is the important characteristic of the Guernseys.

Ayrshires. The Ayrshire breed of cattle was developed in the county of Ayr, in Scotland. These animals are hardy and well adapted to cold countries with short pastures. They are especially noted for their strength and stamina.

A few Ayrshires were imported into New York as early as 1822, and they are still continuing.

The cattle are of medium size and are excellent milk producers. Cows weigh from 1,000 to 1,200 pounds, and the bulls from 1,400 to 2,000 pounds. They are white with red markings, the red being chiefly on the neck and shoulders. The muzzle is broad, and black in color. The horns are long and spreading, usually white in color, with black tips. Ayrshires are very nervous and inclined to be wild. They are popular in hilly portions of the country. The milk production of the Ayrshires is almost equal to that of Holsteins, and the milk contains a fair quantity of butter fat.

FIG. 55. *An Ayrshire cow, Willowmore Elsie Ruth*

Brown Swiss. Switzerland, as the name suggests, is the home of the Brown Swiss cattle. They are used there not only for milk production, but also for beef and as beasts of

burden. Records show that the first importations were made into the United States in 1869. Since the organization of a breed association in 1880, the cattle have been increasing in number.

The animals vary from mouse color to shades of brown. A tuft of light-colored hair may be seen between the horns as well as inside the ears. The tongue and hoofs are black.

FIG. 56. *A Brown Swiss cow, Marie Granger*

The horns are short, flattened in appearance, and extend straight out from the head. In conformation the Brown Swiss are of medium size and approach the beef type. They produce large quantities of milk with a high percentage of butter fat.

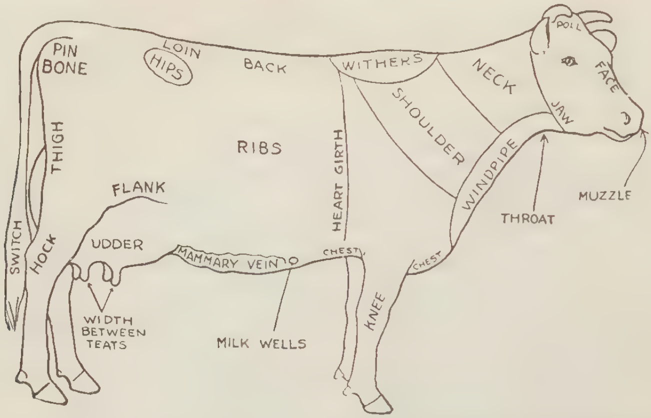
Starting a herd with calves. It is possible to build a valuable dairy business by properly selecting and raising calves. The best cows will probably produce good calves, and a few years of selecting and careful breeding may enable

a farmer to own a valuable herd. In raising calves, they may be fed whole milk or skim milk until they are old enough to eat grain and grass. The calves raised by hand may be allowed to nurse from the cow for four days. For the first two weeks after taking the calf away from its mother, it may be fed about ten pounds of milk each day at regular intervals. Some dairymen feed the calves three times each day. The milk should be clean and warm. Skim milk may be introduced gradually. When the calf is a month old, it may begin to eat some ground grain. Clean water, salt, hay, and comfortable quarters are necessary for the health of the calves.

Starting a herd with cows. Many dairymen depend upon buying cows that are already developed. To do this successfully a thorough knowledge of the good and bad qualities of cows is necessary. One may buy an old cow, a tubercular cow, a kicker, a hard milker, or a poor producer. Some of these objections may be discovered by observation of the cow, but others are found only after a very careful examination. It is advisable to visit the farm and see the cow milked before buying her. Registered cows are desirable because they have pedigrees showing their ancestors for several generations. Many dairymen have kept records of their milk production, so it is possible to know about what the cow can produce. These records cost money, and the buyer pays for them in the price of the cow. Young cattle are usually a safe investment because they may produce beef if they are not good for other purposes. Chance judgments on grade or scrub cows are largely a matter of luck, and the final cost of such cows is greater than that of a good cow with a known record.

Judging by records. It is not difficult to keep a record of the quantity of milk produced by a cow. A spring balance and a record card for each day of the month may be placed

in the barn just back of the cows. As soon as the milking is completed, the milk may be weighed and the record made. At the end of the month, an average of the number of pounds



Courtesy International Harvester Company

FIG. 57. *The parts of a cow. Refer to the parts indicated in using the score card*

may be made. Estimating the quantity of feed eaten by the cow, it will be easy to decide whether the cow has paid for her feed. Determinations of the percentage of butter fat are made by means of the Babcock test.

Judging from appearances. You cannot always judge a cow by her looks, but there are certain characteristics which have been associated with good dairy cows. A cow may have all the good points and still be a poor producer, or she may not have a desirable appearance and still be a good milker. However, in buying cows, it is safe to compare the cow with the following standard for judging dairy cattle:

Conformation. True to dairy type as viewed in passing round the animal.

Head. Neat, medium size, free from excess flesh, and denoting good breeding.

Nose. Should be broad, nostrils large, tissue lining clean and healthy.

Eyes. Large, bright, and not defective.

Horns. True to breed and free from injury.

Ears. Medium size, hair soft and yellow, waxy discharge on inside.

Neck. Long, thin, and slightly drooped.

Shoulders. Tapering at withers and wide enough in front to give good lung capacity.

Front legs. Should be wide apart and placed well under the animal.

Hind legs. Wide apart, strong, and well proportioned.

Back. Straight from the shoulder to the root of the tail.

Ribs. Well sprung and far apart.

Barrel. Very large, and well proportioned, denoting feeding capacity.

Rump. Long, top line straight from point of hips to the tail.

Hip bones. Wide from point to point.

Pin bones. Wide apart.

Skin. Soft, thin, with oily secretions.

Bones. Medium size.

FIG. 58. *The lines represent the triangular structure of a good dairy cow*

Teats. Rather large, four in number, not leaking, and easily milked.

Udder. Large, globose in shape, fastened closely to body, milk veins prominent.

Temperament. Active, docile, and not vicious.

FEEDING AND CARING FOR COWS

Factors. Points to be observed in feeding dairy cows are as follows:

1. Palatability of the feed.
2. Cost of the feed.
3. Home-grown feeds.
4. Kinds of feeds that may be purchased locally.
5. Is the cow milking or dry?
6. Size of the cow.
7. The quantity of milk produced by each cow.
8. Do the animals have access to pasture?

Grain feeds or concentrates. While it is always advisable to produce as much grain or concentrated feeds at home as possible, it is sometimes necessary to buy a portion of the feed. Concentrates are those feeds which contain a large percentage of carbohydrates, starches and sugars, fats and proteins. In buying ground feeds, a high protein content is desirable for milk cows. Reliable feed dealers can make statements of the amount present in certain kinds of feed. These may be bought separately and mixed at home with other grain. Corn is grown extensively and is one of the cheapest starch concentrates. Alfalfa or clover hay will provide the protein. Wheat bran contains proteins and is very good feed for cows. It is rather bulky in texture and serves an important function in promoting digestion. Shorts or wheat middlings are similar to corn in composition, and are used extensively in the rations of dairy cattle. Ground oats is a valuable feed and may be fed at a profit. Cottonseed meal, a by-product of the cotton industry, is rich in protein and is very valuable in balancing rations. It should be fed in small quantities, limited to one or two pounds daily. Linseed meal, a by-product of the flax plant, is fed for its protein content and its laxative effect.

Roughage. That portion of the plant made of woody and fibrous tissue is known as roughage. Hay from legumes, as alfalfa, clover, cowpeas, and soy beans, is very valuable feed on the dairy farm. From twelve to fifteen pounds are fed to each cow per day. Timothy hay and corn stover provide an inferior kind of roughage. Oat or wheat straw is satisfactory. Many farmers allow their cattle to get most of their roughage by eating around straw stacks. Corn silage is a valuable succulent feed. Beet pulp is used extensively in sugar-beet districts.

Balancing rations. Cows need some roughage and some concentrates in their daily supply of feed. If the former is provided by pasture, the balanced ration is obtained by giving the proper kinds of grains. Materials are needed for maintaining the body, and this maintenance ration should be provided before we begin to figure upon the quantity necessary for milk increases. If the cows are increasing in milk production, more grain and roughage should be fed. Dairymen recommend the feeding of one pound of grain daily for each pound of butter fat produced by the cow per week. For example, if she produces seven pounds of butter per week, she should have seven pounds of grain mixture daily. Another rule that is followed with beneficial results is that of feeding one pound of concentrates for every three or four pounds of milk produced, if the milk tests as much as 4 per cent butter fat.

In feeding roughage, it is a good plan to mix leguminous hay with other roughage. The animals may be fed all that they will consume. If pastures are good, very little if any roughage will be needed during the spring and summer months.

Clean milk production. Germs of disease live and thrive in milk, just as other animals thrive by drinking it. It does not require very much time for the bacteria to grow from a

few to millions. They come from the dust particles and filth which may get into the milk soon after it is taken from the cow. Suggestions for production of clean milk follow:

1. The cows should be in good health and their bodies free from dust or dirt at milking time.

2. The barns, milk sheds, and lots should be clean and sanitary.

3. The milk utensils should be clean and sterilized.

4. The milkers should be clean and free from disease.

5. A properly equipped bottling room should be prepared.

6. The workers should have access to cold water, hot water, and steam to clean the milking utensils.

7. A place should be provided for sunning and airing the vessels.

The commercial handling of milk. The average composition of milk according to the United States Department of Agriculture:

Water	87.0 per cent
Protein	3.3
Fat	4.0
Carbohydrates	5.0
Ash	0.7
Total	100.0 per cent

The following kinds of milk and milk products are sold on the market:

1. Whole milk
2. Certified milk
3. Pasteurized milk
4. Skim milk
5. Condensed milk
6. Buttermilk
7. Cream
8. Butter
9. Cream cheese
10. Cottage cheese
11. Milk powder
12. Infant foods

Bottled milk. If one is located near a city or keeps a few good cows in a small town, it will probably pay to sell bottled milk. Regular customers use the milk, and it is important

that the dairyman be courteous, dependable, and business-like in his dealings. If he produces clean milk, sells his product under a guarantee, and follows the best systems of advertising his business, he will find a market for his product.

Selling butter fat. Farmers who keep four or five cows often find it profitable to separate their milk and butter fat with a cream separator, feeding the skimmed milk to the

FIG. 59. *A modern milk room, showing conveniences for handling milk and cream*

calves and selling the cream. The buyers purchase the cream on the basis of the fat it contains. The price varies from time to time, but the practice is generally profitable because very little is removed from the farm, and a steady source of income is assured.

Butter and buttermilk. A large portion of the butter consumed in America comes from small farms where only a few cows are kept and where there is sufficient labor to do the churning and preparing for market. There is always a

good demand for good butter that is fresh, well washed, salted properly, yellow, firm, and neatly molded. Buttermilk is often sold, but it is also an excellent hog feed.

Regular attention to cows. Feed and milk the cows at the same time each night and morning. Milk the cows thoroughly and see that they eat their feed. It is well to brush the cows and wash their udders before milking.

FIG. 60. *A dairy barn of the most desirable type*

Clipping the long hair and washing the udders should be especially practiced during the summer.

Water. Cows drink large quantities of water. Since milk is made largely of water, it is important that all the animals have access to a good supply of water. It may be supplied from streams, wells, or springs. It should be clear, and located where the cows may drink at will. Cold water is harmful to animals in winter. Some dairymen take the trouble to provide individual drinking fountains for each cow.

Salting. Block salt is the best means of providing a constant supply of salt to a large number of cattle. A little salt mixed with the feed may provide an oversupply. The aim should be to allow the cows to have salt when they need it.

Housing. Good barns are considered a necessity in most communities where dairying is an important industry. Some of these may be too elaborate. Generally, they should be warm and well lighted. Steel stanchions and concrete flooring are desirable for sanitary reasons. Artificial ventilation is often included in dairy barns. During the summer it is often advisable to put the cows into the barn during the day to prevent the flies from bothering them. They will obtain sufficient pasture at night.

Diseases. The diseases of cattle are of especial importance to man, because several of them are transmitted through the meat and the milk. It has been shown that whole families have died from tuberculosis taken through the milk. The prevention of such diseases is essential to insure a supply of edible food. Not many years ago, the foot and mouth disease threatened the cattle industry. Outbreaks of Texas fever and anthrax have caused great losses.

Tuberculosis is perhaps the most serious cattle disease in America. Thousands of cattle are infected with the bacteria which cause the disease. Cows may spread the germs to man or to other animals, especially hogs. The United States Department of Agriculture has developed a means of testing cattle to find out whether they are victims of the disease. This work has been done for breeders and dairymen free of charge when they agree to comply with federal regulations. Diseased cattle are to be destroyed, and untested cattle are not to be brought into the herd without an official test.

QUESTIONS

1. What are the advantages of keeping beef cattle on a farm?
2. Name the leading breeds of beef cattle and tell one characteristic of each.
3. Name the grades and types of market cattle.
4. What is a "baby beef"?
5. What points are considered in buying feeding cattle?
6. What is the best method of fattening beef cattle?
7. Name the breeds of dairy cattle and give two characteristics that may distinguish each.
8. Tell how to start a herd with calves.
9. Suggest a number of problems to be considered in buying cows.
10. What is the best way of determining the real value of a cow?
11. Sketch and name the important parts of a dairy cow.
12. Name three problems in feeding dairy cows.
13. Prepare a list of materials used as roughage in your community.
14. How may bovine tuberculosis be eradicated?

PROJECT LESSONS

Exercise I

Object. To learn the proper method of feeding beef cattle.

Materials. Notebook and pencil, various herds of feeding cattle.

Procedure. Among the cattle feeders of your community, find out the age, size, breed, and origin (western or native) of the cattle. Note the kinds of feed used. Write an account of the methods of feeding the cattle from the time they were started until they are marketed. Every farmer has different methods of feeding. Note the time and kind of pasture. Was silage or clover hay used as roughage? What was fed besides corn? How many pounds did each animal average as a daily gain?

Exercise II

Object. To find out the comparative values of milk and cream, by determining the butter-fat content.

Materials. Babcock milk and cream testing apparatus, samples of milk and cream.

Procedure. Uniform samples of milk should be obtained by proper mixing. The application of the Babcock test will indicate the percentage

of butter fat contained in the milk or cream. Four per cent is probably an average, although many Jerseys average 6 per cent.

Conclusions. Make a tabulated report of all cows tested, so that comparisons of the production may be made.

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CHAPTER X

HORSES AND MULES

HORSES

Horses as companions. Aside from dogs, horses are the most companionable animals. They have always been very closely associated with the advancement of civilization. In war and in peace the horse has had much in common with the fortunes of humanity. There is no country in the world to which civilization has not carried the horse. His intelligence and adaptability have made him an ideal beast of burden. His power has been converted into a means of pulling farm machinery, a means of traveling, and into a source of pleasure. The number of horses upon farms in the United States has decreased slightly during the last few years. According to the 1925 agricultural census, there were more than sixteen million horses upon farms. The number of mules has increased until we have almost six million. The decrease in the number of horses may be attributed largely to the increased use of automobiles as a means of travel. It has been estimated that the horses actually doing farm labor are almost as numerous as they were in 1910. There is reason to believe that the horse will continue to be an important factor in food production. There is no doubt that the horse will always continue to be a desirable companion for man.

Classes of horses. (1) The light harness horse is not common in rural communities, but he may be seen in parks, at the horse races, and at horse shows. His body is light, wiry, suited for speed and endurance. Thoroughbreds, Hackneys, and Standardbreds are adapted to light harness activities. (2) The saddle horse is used for carrying people.

His agility and strength, along with superior intelligence, will always make the saddler a very desirable animal. (3) Light draft horses and roadsters include those animals weighing about 1,200 pounds and having a height of fifteen

FIG. 61. *A $25,000 saddle horse, not adapted to farming*

or sixteen hands (a hand is four inches). They were formerly used for pulling carriages and coaches. They are now used as artillery horses and for other military purposes. Morgans and Coaches are the representative breeds. (4) Farmers are more interested in the heavy draft horses weighing over 1,600 pounds. They are adapted to slow movements, pulling plows and heavy wagons.

Qualities of draft horses. Weight enables horses to pull heavy loads without undue exertion. An active animal weighing 1,600 or 1,800 pounds will pull plows with greater ease than a smaller horse. Awkward horses with large joints and poor quality are not desirable. Silky hair, smooth joints, and smooth bones are indications of quality. These points are quickly noted by a trained judge of horses. The eyes should be rather prominent and bright. Fine ears of medium size are desirable. The nostril should be open and of sufficient capacity for breathing. The mouth should be firm without a sagging of the lips. The face should have a kindly appearance. Draft horses have well-developed necks, and shoulders that slope slightly. The feet should be straight, firm, and free from knots or growths above the hoofs. Crumbling or cracked hoofs indicate an inability to travel. The girth and chest measurements should be large, suggesting a sturdy constitution. Long backs are not associated with power in the draft animal, while a short back denotes a strong beast. For pulling heavy loads, square, heavily muscled hind quarters and thighs are important.

Breeds. Horses having the characteristics listed above are good draft animals regardless of breed. The five leading breeds of drafters have been selected with the purpose of producing highly efficient types. None of these breeds is considered superior to the others in general draft qualifications. Adaptability, temperament, and the crossing with inferior beasts have determined the differences of popularity of draft breeds in America.

Percherons. Black and gray horses from that portion of Normandy in France known as the *perche* have become widely known as Percherons. They have long been recognized as valuable animals for use in hauling on the roads. Their speed and endurance were outstanding among large

horses. The American Percheron has retained much of the style and action of his French ancestors. Crossbreeding and the improvement of grade animals indicate that the breed is very popular. The Percheron Society of America

FIG. 62. *A Percheron mare, Maple Grove Cartalena*

is the official organization for registering pure-bred Percherons. Their records indicate that in America Percherons are registered in greater numbers than any other breed. Louis Napoleon was the first noted sire of the breed. He was imported into Ohio in 1851. Brilliant 1271 was another leader of the Percherons. Many noted leaders of the breed have sold for $10,000 or more.

Belgians. While Belgium is a small country, not much larger than three or four counties of our country, its horses

have long been noted for their excellence. Julius Caesar admired the splendid mounts of the Belgians, and it is suggested that he obtained many of them for the Roman cavalry. The great interest in the development of draft

FIG. 63. *A Belgian mare, Irvindale Freda*

animals has become a matter of national pride among the Belgians. Their government has a very effective system of encouraging the careful selection of the best breeding stock by offering prizes and by licensing the best animals. Modern Belgian horses represent a very compact type. The depth of body, fullness of chest and of loins are evidence of a powerful

form. The legs are short, and the horses are rather slow in movement. Bay, sorrel, and roan are the most common colors. Belgians are very gentle animals, probably because their owners for generations kept them very near them, often in the house with the family. American horsemen find that the Belgians mature rapidly, and that they produce good crosses with grades. Perhaps the most noted stallion of the breed in America has been Farceur 7332. In 1917 he sold for $47,500. Many of his descendants have developed into the most excellent draft animals of America.

Clydesdales. Scotland has been the home of some very unusual breeds of live stock, including horses, cattle, and sheep. Perhaps no other country of similar size has had a greater influence upon American breeding. While the Clydesdale horses have not become so popular in the United States, they have a remarkably wide distribution in the British Empire, especially in Canada, South Africa, and Australia. The breed originated in the valley of the river Clyde, near Glasgow. It has been suggested that they were the descendants of Scottish war horses, improved by introductions of English Shire and Belgian stock. Scotchmen insist upon certain breed characteristics, including strong feet and legs. Long, fine, white hair on the legs is a distinguishing feature. Clydesdales probably have the most sprightly and straightforward movement of any draft breed. Their color is bay or brown, with a blaze or white face. The long hair on the legs of Clydesdales collects mud, so they are not used extensively in the black mud of Corn Belt prairies. They have not been found well adapted to farming conditions in the United States. Crossbreds and grades of Clydesdales have been excellent draft animals. Noted sires of the breed are Baron's Pride 9122; his son Baron of Buchlyvie sold for more than $47,000, and Dunure Footprint 15203 was a son of Baron of Buchlyvie. The

American Clydesdale Horse Association is the recognized organization for registering and promoting the breed in the United States.

Shires. Like most of our leading breeds of draft horses, the Shire has been closely associated with British history.

FIG. 64. *A Clydesdale mare, Pride of the Pines*

It was probably this type of horse that pulled the scythed chariots at the time of the Roman conquest. The knights of the Middle Ages used these powerful animals for mounts. It was estimated that they often carried as much as two hundred pounds of armor in addition to the man. Robert

Bakewell, the Englishman who improved breeds of cattle and sheep, is credited with improving the Shire during the latter part of the eighteenth century. The modern Shire is brown or black, with a star or blaze in the face. Extra large size, hairy legs, and coarse structure are characteristic of the breed. The Roman nose and a tendency to stubbornness are common. Shires are the largest draft horses, 1,800 pounds being a common weight. They are correspondingly slow in movement. Their great advantage is

FIG. 65. *A Shire stallion, Edgewood Hengist*

their ability to move enormous loads on solid roads. The American Shire Association registers and promotes the breed in the United States.

Suffolks. The breeders and farmers of southern England have a distinct breed of horses known as the Suffolk. They

are chestnut or sorrel in color, without the hairy growth on their legs found in Shires and Clydesdales. The short powerful body of the Suffolk is also characteristic. Their activity is a very desirable feature. The American Suffolk Horse Association handles the registration and breed promotion work in the United States.

Feeding horses. The temperament and natural tendencies of a horse make it necessary to pay particular attention to feeding him, especially when he is expected to work hard. Some animals require much more feed than others, owing to their greater size and coarser structure. It is important that horses receive their feed three times each day when working. Their stomachs do not hold so much as those of cattle, necessitating the feeding of smaller quantities at regular intervals. The grain ration of a horse may represent a larger proportion of concentrated feeds, such as corn and oats, and the working horse will do better if fed hay at night. Hay and oats provide the best combination while he is working, because they contain sufficient proteins and carbohydrates to insure energy, and the fattening elements are absent.

One of the great problems in the feeding of horses is to provide them with proper nutrition when they are not working. Pasturing and the use of roughage are common practices. A small quantity of corn should be fed so that reserve of energy may be stored for use during periods of work. It has been observed that horses thrive best when they have a small amount of work to do every day. If they are allowed to stand in idleness for a few weeks, their muscles become soft. A horse naturally relishes variety in his diet, because oats and hay are likely to become tiresome. A little linseed meal may be used, and molasses is excellent for fattening lean animals. The latter is usually fed with chopped hay.

Roughage. Hay, straw, and various kinds of stover or fodder are called roughage. Alfalfa or clover hay contains almost a balanced ration for horses. They will become sleek and fat without grain if given a good supply of either. Oat or wheat straw provides an appetizing change for feeding horses during the winter. Corn fodder should never be fed if it is even slightly molded, because it often causes impaction of the bowels and death. Silage may be used very sparingly as an appetizer. The feeder should use some judgment in feeding horses, because some are easily fed too much. Roughage seems to be digested more thoroughly if fed in the evening.

Raising and training colts. The greatest skill involved in any branch of farming is required in handling young horses. It is largely a matter of horse sense. Those colts which have been allowed to run on pasture all their lives are naturally inclined to be wild. The larger and older the colt is before training is begun, the more difficult will be the task. Too many people depend upon the method of "breaking" colts. It is much better to train them while they are young and still going with the mother. It is wise to put a halter upon the colt, letting him follow along beside the mother. In order to accustom the colt to a bridle and bit, it is best to try leading him several times with a bridle.

Colts are not difficult to train to harness if they are not frightened while the harness is first being fitted. After the colt has been led about with his mother, there is little trouble in hitching him to some light object. Many farmers prefer a wagon, but the rattle often frightens a colt. A cart made of the front wheels of the wagon will be better. If the mother is gentle, it is best to tie the colt to the harness of the mare. The colt will soon become accustomed to the harness and will learn to pull.

Most horses of the draft type are not nervous, so that training is a small matter. It is important to keep the colt busy at light work until he has learned to obey. Hard work should be avoided until the animal is approaching maturity. The common training age is between two and three years.

Harnessing horses properly. Heavy loads cannot be pulled unless the *collar fits well.* The surface of the collar should be smooth and fitted to the entire surface of the shoulder. If sores or heavy callouses appear, it is evident that some change should be made in the collar. The *hames* must fit the collar so that the pull from the tugs will press

FIG. 66. *A properly harnessed team. Notice that all parts, especially the collars, fit well*

evenly from both sides. If there is a tendency for the upper part of the neck to become sore, the tugs are pulling too high upon the hames. If the lower part of the shoulder becomes sore, the tugs are pulling too low. The *backband*

and *bellyband* should fit just tight enough to hold the tugs in place. The *breeching* is held in place by the *backband* and *quarter straps.* These are used to hold a wagon with a pole on tongue. The quarter straps are snapped to a *choke-strap* which fastens over the *neck yoke.* When the neck yoke pulls against the choker, the breechings tighten against the thighs of the horse, enabling him to hold back the load. The *lines* pass through rings on the hames to the *bridles.* It is important that the harness be made of good leather, because broken parts usually cause trouble with horses of much vitality. Straps and ropes for tying are necessary. It is often remarked that a horse that is not worth tying is not worth keeping.

The diseases of horses. Again, prevention is better than cure. Most of the troubles of horses are the result of improper feeding. Sudden changes of diet, overheating, and unaccustomed hard work will cause disorders that prove fatal. *Colic,* also known as indigestion, is perhaps the most familiar horse disease. Abdominal pains, restlessness, hard breathing, looking at the side, pawing, and sitting down are symptoms of colic. One pound of Epsom or Glauber salts, followed by one pint of linseed oil, will give relief. A veterinarian should be called if the attack is very violent. *Distemper* is a common disease of colts. It begins with a loss of appetite, abnormal thirst, followed by coughing and running at the nose. A swelling begins at the throat and between the lower jawbones. This swelling may require opening. Flaxseed poultices are very effective in reducing the swelling. Glauber salts may be given to reduce fevers. *Founder* is the overfeeding of an animal until it has lost all control of the functions of the body. The quantity of water allowed should be very small. Linseed or castor oil should be given in large quantities. It requires several weeks or months for foundered animals to recover. The bowels

should be kept moving freely. *Heaves* is a disease characterized by the abnormal heaving of the flanks, "thick wind," and roaring when the horse is exerting himself. It is caused by dusty or moldy feed. By the avoidance of such feed, the symptoms may disappear. Patent heave remedies seldom give relief for any length of time. Abnormal conditions of the joints may cause *bone spavins* which appear upon the hock (ankle joint). The growth is often caused by a bruise or sprain. *Ringbones* are growths just above the hoof, which often appear in colts not having their hoofs trimmed evenly. The correction of the feet and the application of caustic will aid in removing the trouble. *Fistula* is a very disagreeable disease of the skin and muscles, indicated by sores in the skin through which there is a discharge of pus. The infection begins as a result of bruises about the neck and shoulders from poorly fitted harness. The pus sacs may be opened during the early stages with a knife, and disinfection with blue vitriol (copper sulphate) will cleanse the sores. *Glanders* is a very contagious bacterial disease. The lungs, nose, or skin may be infected. The disease is nearly always fatal, lasting from a few weeks to several years. A persistent dry cough is present. Tests may be made to find out whether the horse has glanders by injecting mallatin, similar to the tuberculin test. If horses are definitely known to have glanders, they should be killed immediately, because no successful remedy for the disease is known.

MULES

The increasing popularity of mules. The agricultural census of 1925 shows that there has been an increase of more than 5 per cent in the number of mules upon farms in the United States since 1920. While much of this increase has been in the cotton-producing sections of the country,

there is an increasing demand for large mules in every farming community. Why are mules increasing in number? It is much the same story as that of the army mule. Patience and endurance are outstanding characteristics.

FIG. 67. *This donkey is at home in the "dear, dear old South"*

Mules are adapted to hard work such as road building, levee construction, mining, carrying packs, heavy hauling, lumbering, and general farm work.

What is a mule? A mule is the offspring of a jack and a mare. The external markings such as the shape of the head, ears, mane, legs, size of the feet, and bray resemble the jack. Mules are sure-footed, patient, faithful, and enduring. The shape of the body, hardiness, active temperament, strength, and stamina are probably inherited from the mare. The word "mule" means a nonbreeder or a sterile hybrid. George Washington kept a jack at Mount Vernon and raised some valuable mules. Kentucky and Missouri have been the leading mule states.

Qualities of a good jack. While the original supply of jacks for mule production came from Spain, the American jack has been bred to conform to certain standards that are now considered superior to European production. This

FIG. 68. *A jack, the type used for raising powerful mules*

has been recently shown by the fact that the Spanish government purchased a large shipment of jacks in St. Louis. A good jack should be healthy, of good conformation, fifteen to seventeen hands high, and weigh from 1,100 to 1,200 pounds. The ears, head, and feet should be large. He should have a broad chest and wide hips. The bones should

be of medium size, flattish, firm, and free from ringbones and splints. The animal should be well muscled and devoid of patches of fat over the body. The most desirable color is black with white points.

Breeds of jacks. In southern Europe there are various sizes and colors of jacks, ranging from white through gray, maltese, and brown to black. Some of the most important breeds are: Poitou from France, Catalonian and Andalusian from Spain, Majorcan and Maltese from islands of the Mediterranean. Americans have found that the breeding of good stock is possible in the United States. The American Breeders Association of Jacks and Jennets registers animals of standard quality.

Types of mares used for mule production. Light mares and heavy mares are used for mule production. Well-matured mares of light type produce good general-purpose mules if they are bred to large jacks. Standardbred, German coach, French coach, and Hackneys are breeds of mares desirable for light mules. The breeding of small grade mares to small scrubby jacks produces the worthless mule so common in many farming sections. In breeding for the production of large draft mules, the very best jacks should be bred to grade Percheron, Clydesdale, Belgian, Shire, or Suffolk mares. Regardless of the breed of mare to be used in mule production, she should be free from disease, in good condition, properly fed, and well sheltered.

The types of mules. Mule markets have classified mules into various groups according to their uses. The southern trade demands a rather large mule of the draft type, known as a sugar mule. Smaller animals are needed in the cotton fields. These are generally called plantation mules. Extra large mules are known as lumber mules or levee mules, suggesting that they are to be used in lumber camps or in building grades. Mine mules are the low, compact kind

used in pits and tunnels. Farm mules are generally recognized as a mixed group, usually of inferior quality, adapted to general farm work.

Feeding work mules. While mules are generally credited with being able to do as much work as horses of three hundred pounds more weight, they cannot do it without feed. Mules eat plenty of hay and grain. They may not want grain during the day if they have been working hard, but they consume it at night. Oats at the rate of twenty pounds per day is not too much for a hard-working mule. Ten or fifteen pounds of hay will probably be eaten. Linseed meal and molasses may be mixed with other feeds. A small quantity of each will produce a sleek coat of hair. Mules will do more work if they do not have access to pastures, but it is more economical to let them out during periods of rest. It has often been remarked that a mule will not eat more than is good for him.

Handling mules. An energetic mule colt may cause more trouble than any other animal upon the farm. While he may not be any more inclined to use his heels than a horse, his inquisitive nature often causes him to try fences and gates. If there is a weakness in the top wire of a fence, mules will find it, and they are remarkably clever in opening gates and barn doors. It is often a matter of economy to provide box stalls for individual mules. The training of mule colts requires more precautions than that of horse colts. Good harness and a gentle horse are necessary. The tendency of the colt to get out of the harness may be overcome by a period of preliminary practice with harness in the stall. Successful mule growers often use a pair of strong gates, placing the colt in between the gates to hold him while his mane and tail are being clipped. The same method of holding is excellent in putting on harness. By twisting one ear tightly, a man may hold a mule without danger to himself.

QUESTIONS

1. Why have horses been so important in the history of the human race?
2. Name the five common breeds of draft horses.
3. What constitutes a good draft horse?
4. Why should horses be fed regularly?
5. What is the purpose of roughage in feeding horses?
6. Tell how to train a colt.
7. Why should a horse collar fit well?
8. Name five diseases of horses.
9. What is a mule?
10. Name three breeds of jacks.
11. What kinds of mares are best for raising mules?
12. Give some general rules to follow in feeding mules.
13. What height and weight of mules are best for farmers of your community?
14. Is a mule colt more difficult to train than a horse colt?

PROJECT LESSONS

Exercise I

If two or three good draft horses are available in the community, the class should try to apply the following score card, listing the comparative points of each animal and totaling them to find out how the animals compare. Ask a competent farmer to decide which is the best draft horse.

SCALE OF POINTS FOR DRAFT HORSES

	Perfect Score
General appearance:	
Weight: over 1,500 lbs., score according to age	4
Form: broad, massive, proportioned	4
Grade: bone smooth and hard, tendons lean, skin and hair fine	4
Temperament: energetic, good disposition	4
Head and neck:	
Head: lean, medium size	1
Muzzle: fine, nostrils large, lips thin and even	1
Eyes: full, bright, clear	1
Forehead: broad, full	1
Ear: medium size, well carried	1
Neck: muscled, crest high, throatlatch fine, windpipe large	1

	Perfect Score
Fore quarters:	
Shoulder: sloping, smooth, snug, extending into back	2
Arm: short, thrown back	1
Fore arm: heavily muscled, long, wide	2
Knees: wide, clean cut, straight, deep, strongly supported	2
Cannons: short, lean, wide, sinews large, set back	2
Fetlocks: wide, straight, long	1
Pasterns: sloping, lengthy, strong	3
Feet: large, even size, horn dense, sole concave, bars strong, frog large and elastic, heel wide, one-half length of toe and vertical to ground	8
Legs: viewed in front, a perpendicular line from the point of the shoulder should fall upon the center of the knee, cannon, pastern, and foot. From the side, a perpendicular line dropping from the center of the elbow joint should fall upon the center of the knee and pastern joints and back of hoof	4
Body:	
Chest: deep, wide, low, large girth	2
Ribs: long, close, sprung	2
Back: straight, short, broad	2
Loins: wide, short, thick, straight	2
Underline: flank low	1
Hind quarters:	
Hips: smooth, wide	2
Croup: wide, muscular	2
Tail: attached high, well carried	1
Thighs: muscular	2
Quarters: deep, heavily muscled	2
Gaskin or lower thighs: wide muscled	2
Hocks: clean cut, wide, straight	8
Cannons: short, wide, sinews large, set back	2
Fetlocks: wide, straight, strong	1
Pasterns: sloping, strong, lengthy	2
Feet: large, even size, horn dense, dark color, sole concave, bars strong, frog large and elastic, heel wide, one-half length of toe and vertical to ground	6
Legs: viewed from behind, a perpendicular line from the point of the buttock should fall upon the center of the hock, cannon,	

	PERFECT SCORE
pastern, foot. From side, a perpendicular line from hip joint should fall upon the center of the foot and divide the gaskin in the middle; and a perpendicular line from the point of the buttock should run parallel to the line of the cannon........	4
Action:	
Walk: smooth, quick, long, balanced........................	6
Trot: rapid, straight, regular..............................	4
Total..	100

EXERCISE II

Find out from ten practical farmers the kinds and quantities of feed being given to mules. From this information, estimate the cost of keeping a team of work mules for one year. Learn to tell the ages of mules by their teeth.

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CHAPTER XI

HOGS

Pork profits. The farmers of the United States raise about sixty million hogs each year, and their 1920 crop was valued at almost one billion dollars. With a population of approximately one hundred millions, the value of pork available for each person approaches ten dollars. Each farm in the United States averages twelve hogs. The average price paid for hogs in 1920 at the larger markets was eleven cents per pound, almost twice the price paid in 1910. The difference would indicate that the increased population is demanding more food.

Marketing grain on the hoof. Farmers who raise corn as a principal crop find pork production a convenient way of disposing of their surplus grain. It has become a common slogan that farmers raise more hogs to eat more corn, to buy more land, to raise more hogs, etc. This would not be the case if the practice were at all unprofitable. Difficulties in obtaining laborers to harvest the corn crop have caused farmers to practice "hogging-down" their fields. They find that labor is saved, fertility is left upon the field, and their hogs are ready to sell without any unnecessary expense. Driving a carload of hogs to town does not involve one-tenth the labor that husking and cribbing corn would necessitate. They actually market their grain on the hoof.

Changes in the hog industry. Our grandfathers often recall the good old days when acorns and hickory nuts were the sources of fattening materials for porkers. The pigs ran in the woods and fattened during the autumn. Those not used for family consumption were driven to a market, perhaps several miles away. The "Elm Peelers" and

"Razorbacks" were recognized kinds of hogs. Their names suggest the quality of the animals, and their ability to thrive without any special care is undoubted. As the great forests were cleared away, corn was grown more extensively. The modern hog industry did not begin to develop until the prairies were being settled. Corn became a major crop, and hogs changed from half-wild foragers to pork producers. Lard was much desired and became the principal pork product. Hogs producing a large quantity of lard were in demand throughout the Corn Belt. Breeders responded to the lard demand by producing a short, fat type of hog. Where less corn was grown, the "bacon hog" was produced. Until the World War, "lard" and "bacon" hogs represented two distinct types of porkers. Substitutes for lard are now being made to such an extent that our hogs have changed from lard and bacon to a medium type that might well be called a "pork-chop" hog.

The most desirable type. The animal that produces the highest market value at the smallest cost is the one to grow. A long arched back, with deep sides and firm quarters, has become the standard of pork production. There is very little surplus fat upon the modern hog. Fine hair is an indication of superior quality and economical gains. The well-covered, deep loin is especially desirable, because the heavier cuts of meat from the loin bring a higher price. Packers and butchers naturally wish to buy hogs having the smallest proportion of waste in the process of dressing.

Qualities of breeds. In attaining the above aims, farmers and breeders have used various plans of selecting their breeding stock. The wide differences between the various breeds, so pronounced a few years ago, are now limited to color. While there are many virtues in each breed of hogs, the farmer should select a desirable breed and get the best results possible. If the neighbors are raising one kind of

hogs, it is advisable to adopt their breed. It is very discouraging to have black hogs in a community where white or red predominate. It has been found most profitable to maintain a pure breed rather than to try a mixture of all the breeds. The first cross of two breeds may produce feeding hogs that are better than some pure-breds, but a continued crossing is harmful. A community may often profit by raising only one breed of hogs. Better sires may be obtained. Hogs of one breed often sell for a higher price than a mixture. A pure-bred gives a farmer a certain pride in his kind of live stock. The fact that our hogs have come from a long line of prize winners gives us satisfaction.

Breeds. Like most of our farm animals, hogs were originally brought from England. Black, white, and red hogs were represented by the Berkshires, Yorkshires, and Tamworths in the order named. Large black hogs and Black Essex were common. American farmers made importations of hogs from Poland and some from southern China. Various developments of the above and selections have given us our eight or ten breeds of pork producers. Continued improvement by selection and breeding developed the breeds until farmers felt the need of forming definite organizations for promoting them. A National Swine Breeders Convention was held in 1872 to define the various breeds and to establish standards of perfection. Since then various national organizations have been established to record the names and numbers of these pure-bred hogs. The work has become so general that every farm may have registered breeding stock at a very slight additional cost. The ancestry of animals has a considerable influence upon the young, and we should study the pedigrees of the sires and mothers of the better families of our favorite breeds.

Duroc-Jersey. According to registration records and sales in central stock markets, the Duroc-Jersey hogs are

the most popular at the present time. They are light or dark red hogs. The most prevalent type in the early history of the breed was the short fat type. Larger-boned and heavier animals are now raised. They have been bred to show quality and remarkable smoothness. Durocs are especially desirable because the sows are good mothers, the pigs grow rapidly, and are ready to market early. The hogs cross well with other breeds and adapt themselves to farm conditions of all sorts. Some noted families of Durocs are outstanding. Colonels, Orions, Defenders, and Cherry Kings are names of families of Durocs. Unusual prices have been paid for some of the leaders of the breed, $31,000 being the highest for a noted sire.

Poland-China. Large black hogs once enjoyed the popular favor almost to the exclusion of other breeds. They are supposed to have originated by the crossing of Russian pigs with those imported from China. The Shakers, in Warren County, Ohio, are supposed to have originated the breed. The small and medium types of Poland-Chinas were popular some years ago, but the big-type Poland is now the standard. They are long, large-boned animals. White feet and a white nose with some white spots are common. Poland-Chinas represent extremes of breeding and of quality. Some breeders have advertised and exploited the extreme big type during recent years to such an extent that farmers have ceased to raise them. The hogs are not readily adapted to new surroundings, and the extreme size has become a handicap. Some noted families of the breed are represented by Giants, Oranges, Liberators, Clansmen, and Giant Busters. Poland-Chinas have sold for higher prices than any other breeds of swine, a reputed $60,000 having been paid for one sire, the Yankee.

Chester Whites. In Chester and Delaware counties, in the southeastern part of Pennsylvania, white hogs were

FIG. 69. *A Duroc sow, Originator's Queen*

FIG. 70. *A pork-chop hog, champion Duroc barrow*

FIG. 71. *A spotted Poland-China sow, Advance Lady*

FIG. 72. *A Poland-China sow, Liberator's Best 2d*

FIG. 73. *A Chester White sow, Giantess A*

FIG. 74. *A Yorkshire sow, Deer Creek Rosa 7th*

FIG. 75. *A Berkshire sow, Barron's Helen 2d*

FIG. 76. *A Tamworth sow, Home Farm Baroness IX*

very popular more than one hundred years ago. By the selection of the best animals from the point of view of maturity and quality, a pure-white breed was developed. They became known as Chester Whites. Later, in Ohio, the breed was crossed with other white hogs, and the Ohio Improved Chester (O. I. C.) became a very popular breed. The modern type of Chester is not greatly different from the Duroc and the big-type Poland, with the exception of color. Their white skin makes Chesters especially desirable for clean, smooth carcasses. Unfortunately, they tend to blister in the hot sun. This limits the territory in which farmers raise them to the cool northern portions of the country.

Berkshires. The oldest modern breed of hogs probably came from Berkshire, England. Berkshires are readily recognized by their glossy black color and their hooked noses. While much contempt has been expressed for the hook on the Berkshire nose, it is undoubtedly an aristocratic snoot. It has been suggested that the Berk is better suited to grazing and a longer period of growth than other breeds. The hams and bacon are considered superior to those of other breeds. The Berkshires' size does not compare with the extremes of other breeds, but hardiness and ability to graze has made the Berks very popular in some sections.

FIG. 77. *A Hampshire sow, Pershing Lady*

Hampshires. The hogs that always appear in dress suits are the Hampshires, better known as Hamps. Their very proper white collars and black coats provide an unusual appearance when they arrive in large numbers at the market. The quality of their dress is also characteristic of their hams and bacon, which accounts for their rapid increase in popularity. Packers

pay a small premium for the extra quality of the meat and for the slightness of the loss in dressing.

Bacon hogs. Yorkshires and Tamworths are the original bacon hogs. Their lean bodies represent inherited characteristics of the original English pigs. They are excellent grazers and are adapted to regions where very little corn is grown. The Yorkshire is a white hog with a turned-up nose, large ears, and a large head. The Tamworth is red, like the Duroc, but he has an unusually long nose and legs. Both breeds are very prolific, and there are many advantages in crossing them with other types.

The best breed. The individual mothers and sires will determine the success of a herd of hogs, rather than the characteristics of the breed. The reason for maintaining a pure breed of hogs is that we may know what may have been the quality of the sire, grandsire, and great-grandsire of the present stock. If they have all been hogs of the best quality, we may be reasonably sure that the pigs will be good. Pedigrees show how many pigs have been raised in the preceding generations, and farmers should obtain those representing the most uniform production.

Starting the pigs. After the breeding stock has been well selected, the real test of a successful hog man is his ability to care for the animals and to produce the best crop of porkers. The beginning should be made with the mother, by feeding her a well-balanced ration and allowing plenty of exercise. During the winter it may be desirable to feed some distance from the sleeping quarters so that the hogs are forced to exercise. Hay, fed in a self-feeder, should be a portion of the ration for the brood sow. Alfalfa, clover, or soy-bean hay is most appetizing and provides proteins in sufficient quantity.

With a properly nourished mother, the pigs are vigorous and active when they are born. However, it is important

to see that the mother has a comfortable place, away from other hogs, at farrowing time. A stall in the barn or a portable hog house should be provided. It should be free from lice or parasitic worms. For the first twenty-four hours after the pigs arrive, the mother should have only water, because grain or rich food may cause sickness. Skim milk is a very good form of nutrition to break this fast, and

FIG. 78. *A promising family of porkers*

the quantity of feed should be increased slowly. Too much concentrated feed may cause the pigs to scour and become stunted.

When the pigs have begun to look for other feed, it is well to start them with cracked grain. Experienced hog feeders have found that slop does not obtain best results with young pigs. It has been noted that pigs started with a self-feeder do not require weaning, or, rather, they wean themselves. This plan is based upon the assumption that they have plenty of pasture and a balanced ration in the self-feeder.

Growing pigs. After the pigs are two months old, if they have not already weaned themselves, it is time to take the

mother to a separate pasture and to start the pigs on their way to market. The next two months should be a growing period, characterized by a rapid increase in bone and muscle. During the summer it is easy to provide good pasture for the pigs—clover, alfalfa, or rape. To get the best results, a self-feeder containing tankage and wheat middlings or barley will be found profitable. Many farmers neglect

FIG. 79. *Hogging down corn and soy beans. Note that much of the corn is not reached until the pigs have eaten all that is on the ground. A low-eared variety of corn is preferable for this purpose*

water during the warm weather. A drinking fountain is not expensive. Winter feeding involves more attention and better preparations. Corn Belt farmers often allow the pigs to feed in cattle pens without any other attention. It is quite necessary to see that pigs get plenty of warm drinking water or slop during the cold days. If they get a warm drink twice each day, with plenty of protein feed, they should gain almost as much in winter as in summer. Many breeders provide a large boiler to heat the water. Gains made during the growing period are expensive if corn

is the principal food. It is much better to use protein foods and very little corn.

Finishing hogs for market. At the age of four months a pig should have sufficient growth to put on fat for the market. He should weigh about one hundred and twenty-five pounds. In the fall, finishing is a matter of hogging down corn. It provides the least expensive gain and saves the expense of harvesting the crop. A small portion of a field should be opened at a time by fencing with a temporary fence of woven wire. The following table from the Minnesota Experiment Station will show how much corn will be needed for fattening the hogs:

Twenty hogs weighing 125 pounds each will clean up an acre of corn yielding:	Sixty hogs weighing 125 pounds each will clean up an acre of corn yielding:
40 bushels in 15 days	40 bushels in 5 days
50 bushels in 19 days	50 bushels in 6 days
60 bushels in 23 days	60 bushels in 8 days
70 bushels in 26 days	70 bushels in 9 days

Early corn or sweet corn is profitable because the hogs may be started early in the smaller field. By the time the larger corn has become hard and dented, the porkers will have become accustomed to corn so that they may make a more rapid gain. Experiments have shown that greater gains may be made if tankage and other proteins in self-feeders are fed along with the corn. Water is very necessary, and drinking fountains should not be neglected.

Winter feeding. Cold weather probably causes animals to eat more for the same amount of gain than they do in warm weather, but the profits are also greater. Warm shelters should be provided, and a supply of warm drinking water is important. Successful hog feeders build concrete feeding floors so that corn may not be wasted. They have also learned that hogs do much better in small herds of

twenty or thirty than in droves of a hundred. Pigs thrive when following after cattle, using waste corn or other feed.

Marketing. The majority of hogs sold by farmers at central markets weigh from two to three hundred pounds. It should be the aim of every farmer to have his hogs weighing about that much at a time when the demand is greatest and when the price is correspondingly high. The great movement of hogs from the Corn Belt begins during October and continues through November and December. Prices usually decline, and many hogs are sold at a loss. If some of the hogs could be marketed in August and September, there would not be the sudden decline in prices. If a part of the hogs sold in May and June could be ready for market in March and April, the general prices would not experience such wide changes.

Hog sanitation. If feeding and marketing the hog were the only problems in pork production, the swine industry would be unusual and highly desirable. Enormous losses have been suffered annually by hog growers as a result of diseases. Hog cholera, tuberculosis, worms, and swine plague are the most destructive. Prevention is much better than cure for any of these diseases. Proper sanitary measures must be observed for hogs as well as for other animals. We often think of the pig as being naturally filthy, but he is not. He does not wallow in the mud to enjoy the sensation of a mud bath. His aim is to keep cool. In fact, he will thrive just as well without the mud bath if he has a cool shade to protect him from the hot sun. An artificial shade is better than none in the hog lot. If the farmer considers it necessary to have a hog wallow, it should be made of concrete and kept full of clean water.

Streams carry a number of diseases. Hog cholera has been known to be transported downstream from farms above. Thousands of hogs become infected with tuberculosis

every year by being fed milk from tuberculous cows. Wastes from small packing houses used for feed, and filthy quarters are sources of disease. Worms live from year to year in the soil of hog lots. When the eggs of these are taken into the stomach of the rooting hog, they hatch and the worms take the nutrition of the pig. Small pigs become infected while with their mothers; their hair becomes rough and they do not grow well. Thumps and wheezing are caused by worms in the lungs. Swine plague seems to be caused by bacteria after the hog's constitution has been weakened by unfavorable conditions.

An ounce of prevention. Hog diseases are much more easily prevented than they are cured. The hog in his native state did not have many diseases. He inhabited mountainous districts where there was fresh water, dry leaves for making a nest, and a wide range. Man has moved him to the plains, and penned him into crowded lots and into forced company with diseased animals. While we can hardly let the pigs run wild as they did at one time, we can at least see that they get fresh water and a clean place to sleep. Hogs should not be kept in one lot for several years. Rotate the hog lots, plowing up the old one for a truck garden. Provide temporary pastures so that the breeding stock may be kept in small fields, changing once each month.

Cholera prevention. In addition to sanitation and rotation of pastures, cholera may be prevented best by vaccination. Veterinarians inject immunizing fluids into hogs so that cholera may be prevented during the natural life of the hog. The terms "double immune" or "immuned with the double treatment" are most commonly known to farmers. A cholera *serum* is injected which will prevent immediate infection from cholera. This is followed by a *virus* which will immunize the hog for life if sufficient quantities are used. It is important that such treatment be given only

to uninfected pigs, because the injection will often kill those already diseased.

Destroying vermin. Disinfectants are important in providing for the health of porkers. Hog lice are very common if hogs are allowed to sleep around old straw stacks. They may be seen crawling over the backs and around the ears of the pigs. The eggs of lice, which look like little white seeds,

FIG. 80. *Hogs applying oil with a modern oiler*

may be seen attached to the bristles of the hog. They are called "nits." An application of oil by means of a hog oiler will prevent lice. Hogs naturally rub about pens, and the oiler is a favorite place. Mange may also be prevented by the use of heavy oil. These oilers may be purchased, or they may be made of burlap and rope wrapped about posts and soaked with old cylinder oil. Worms may be eliminated if a box of charcoal, copperas, and salt, mixed, is supplied. In severe cases it is advisable to have a veterinarian give the hogs a worm treatment. Cleaning old nesting places and a change of pastures will do much to get rid of vermin.

Breed associations. In keeping up the registration of pure-bred hogs it is necessary to have their names and numbers registered by the secretary of one of the national breed associations. This may be done by writing to the secretary, who will mail an application blank. This blank gives full instructions in regard to registration. A list of national associations for the registration of pure-bred hogs follows (address the secretary):

American Berkshire Association, Springfield, Illinois.

American Duroc-Jersey Swine Breeders Association, Union Stock Yards, Chicago, Illinois.

American Hampshire Swine Record Association, Peoria, Illinois.

American Large Black Pig Society, Lexington, Kentucky.

American Poland-China Record Company, Union Stock Yards, Chicago, Illinois.

American Tamworth Swine Record Association, Carthage, Illinois.

American Yorkshire Club, White Bear Lake, Minnesota.

Chester Swine Breeders Association, Freeville, New York.

Chester White Record Association, Rochester, Indiana.

Improved Small Yorkshire Club of America, Espyville, Pennsylvania.

National Chester White Record Association, West Chester, Pennsylvania.

National Duroc-Jersey Swine Breeders Association, Peoria, Illinois.

National Mulefoot Hog Record Association, Degraff, Ohio.

National Poland-China Record Association, Winchester, Indiana.

National Spotted Poland-China Record Association, Bainbridge, Indiana.

O. I. C. Swine Breeders Association, Goshen, Indiana.

Standard Poland-China Record Company, Maryville, Missouri.

United States Small Yorkshire Association, California, Michigan.

QUESTIONS

1. What is the average number of hogs upon each farm in the United States?
2. What is the most desirable type of market hog?
3. Why should the parents of a pig be considered in growing good market hogs?
4. Explain a method of starting pigs to eat grain.

5. What kinds of pastures are most desirable for hogs?
6. How are the hogs of your community marketed?
7. How may we prevent diseases in hogs?
8. What is meant by the rotation of hog pastures?
9. How is hog cholera prevented?
10. What is the purpose of a hog oiler?
11. Why do pigs need charcoal and salt?
12. Name the most common breed of hogs in your community.

PROJECT LESSONS

Exercise I

Write a letter to the secretary of the breed association registering your favorite breed of hogs and asking him to mail you registration blanks and rules for registering hogs. Read these carefully and try to fill in the blank applying for the registration of a pig.

Exercise II

Organize a pig club and arrange to raise pure-bred pigs.

Exercise III

Secure the assistance of an experienced hog judge and visit a good herd of hogs. Learn the more important points to be considered in selecting good hogs. Note the straightness of feet, strength of limb, arch of back, smoothness, shape of head, and conformation to type of the hogs.

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CHAPTER XII

SHEEP AND GOATS

SHEEP

When Jacob went to keep his Uncle Laban's flocks, the sheep industry was probably already very old. Three thousand years have not diminished the importance of sheep as sources of food and clothing. The increase in the world's population has been accompanied by an increase in the uses of wool and sheep products. While there were not so many sheep in the United States in 1920 as there were in 1910, the value has increased greatly, indicating that the number of sheep now raised is not sufficient to meet the demands. Recent increases in the price of wool and lambs emphasize the importance of keeping more sheep.

Utilizing wastes on farms. While only a small portion of our farming population, living in mountainous regions, is interested in sheep farming exclusively, every farmer can keep a few sheep as scavengers. Farmers who keep a small flock of sheep do not have fence rows overgrown with brush and weeds. Twenty sheep for each one hundred and sixty acres of farm land have been found to represent almost a clear profit. They pasture idle fields and fence rows during the summer. Grassy cornfields are pastured in the fall without much damage to the corn.

Inexpensive wintering. Caring for sheep in winter is less trouble than for cattle and hogs. The sheep may eat less expensive roughage, such as fodder and straw. Estimates indicate that a sheep will gain a pound with only five pounds of grain, if sufficient roughage is added. It is not advisable to feed much grain to breeding stock. Hay

and straw are better. Housing is not such an important problem as with other animals, because sheep thrive better in open sheds which protect them from rain and snow.

Two profits from sheep. The direct profits from sheep are represented by the wool and mutton produced. A very ordinary sheep will produce two or three dollars' worth of wool each year. When the ewe has passed her period of usefulness, she may be sold for a few dollars for mutton. The indirect profits from sheep are obtained from the lambs and from their work as scavengers. Lambs from the larger breeds of sheep grow to a marketable size within three or four months. Those produced in barns during the winter sell for a high price early in the spring. Summer lambs represent a very inexpensive gain.

Why farmers do not keep sheep. If the profits from sheep are so easily obtained, it might seem reasonable to assume that every farmer would have a flock of sheep. Only a very small percentage of the farms of the Corn Belt maintain sheep. Farmers explain that dogs kill sheep, perhaps a neighbor's dog. Diseases of sheep which are difficult to prevent are common. More important than all of these is the fact that sheep need to be sheared at about the time corn is to be planted. It is not convenient for a farmer to neglect his most important crop to shear a few sheep. Cattle and sheep do not thrive in the same pasture. Unless the lambs can be marketed in large numbers in the larger markets, the selling price is too often disappointing. But as a by-product of small farms sheep have more than paid for the inconvenience of keeping them. While it is true that many swampy regions are not suited to sheep production, there are thousands of acres of hilly and mountainous regions that could profitably be devoted to sheep raising.

Protection from dogs. It is not often that a well-fed dog will kill sheep. A lack of meat has caused old dogs to kill

sheep, and they are often followed by younger dogs. About the only remedy for such an unfortunate habit is to kill the dog. Usually a sheep-killing dog is a coward, and three or four Angora goats will protect a large flock of sheep. Their sharp horns are almost certain protection against dogs. A strong male goat can very readily bluff a whole pack of dogs.

FIG. 81. *Feeding lambs*

Feeding sheep and lambs. Stockmen divide feeding sheep into two classes, native and western. Native sheep are those grown upon the farms of the eastern states, while westerns are those coming from the great ranches and open ranges of the Rocky Mountain regions. Western sheep are usually considered more vigorous and may produce a better grade of mutton than the native. The western lambs are perhaps the more popular for grain feeding because they may be purchased in large numbers in central markets at prices less than the cost of raising native lambs. When they are turned into a cornfield, their gain is remarkable.

Self-feeding. After lambs have reached a weight of sixty or seventy pounds, they are usually put into lots for finishing. Old sheep may also be fattened best in lots. Self-feeders, similar to those used for feeding hogs, but elevated six or eight inches above the ground, are provided. These are usually kept filled with ground feed. Corn and oats in equal parts make an excellent feed. Flaxseed or cottonseed meal may be used profitably for producing a "finish." The use of ground alfalfa and molasses has been found profitable for fattening old sheep. Clover or some other leguminous hay should also be fed in a self-feeder along with the grain. If the feeders are properly constructed, very little grain and hay will be wasted, and the grain will cost less per pound.

Pasturing. During the greater part of the year, sheep will find enough grass to keep in good flesh if the pasture is not overcrowded. Owing to the fact that sheep are subject to many parasitic worms, it is necessary to rotate their pastures, changing once each month. This may not be necessary in the larger fields of the West, but it is very important upon smaller farms. This plan prevents the pastures from being eaten too closely and provides variety for the sheep. Salt is important for sheep. A supply should be provided so that they may eat what they want.

Care of lambs. The most critical phase of sheep raising comes during the cold nights of March and April when the little lambs are arriving. The young ones are easily chilled to death. This is especially true if they are allowed to remain in a wet lot while it is raining. A warm dry shed is important, and the lambs often require warming before a fire. As soon as they have recovered from their chills, they may be returned to the mother. Sometimes mothers do not claim their lambs. This difficulty may be overcome by holding the mother until the lamb has his first meal. When

lambs are two weeks old, they should be docked. The tails should be removed two inches from the body.

The development of lambs is remarkably rapid, and they may eat a small quantity of chopped grain very soon after they begin to frisk and play. There are some advantages in raising winter lambs. They are often called "hothouse

FIG. 82. *Clipping sheep may be accomplished with a small hand machine or with one driven by a motor*

lambs" because it is necessary to provide protection for them. They command a very high price and often justify the extra expense. Lambs weighing eighty-five pounds are considered the choice for marketing.

Shearing sheep. When the weather becomes warm in the spring, heavy coats of wool grow burdensome to sheep. As soon as it becomes oily, the fleece should be removed. Sheep are clipped with a clipping machine. Fleeces are carefully rolled and tied with a wool twine. Clean wool sells for more than that filled with burs and chaff. The average

FIG. 83. *A Shropshire ewe*

FIG. 84. *An Oxford, a substantial mutton type*

weight of a fleece in the United States is a little over six pounds, but good sheep produce as much as ten or twelve pounds. Southwestern sheep growers usually shear their sheep twice each year.

Diseases. Sheep are perhaps the most difficult animals to treat when they are sick. They have four stomachs instead of one, and a large part of their trouble is found in the fourth stomach and the intestines. Many diseases are caused by animal parasites, others by bacteria, and some by abnormal conditions of the body. Sheep are usually free from diseases if they have enough feed, are not overcrowded, and have a change of pasture and dry surroundings.

Stomach worms infest the fourth stomachs of sheep. They are long white worms which rob the animal of nutrition and vitality. Three or four tablespoonfuls of a weak solution of creosote will aid in destroying the worms. Areca nut may be fed to some advantage. *Lung worms* cause coughing by attaching themselves to the windpipe. A change of pasture is advisable, with an injection of olive oil and turpentine into the windpipe.

The *liverfluke* is a common parasite in the livers of sheep having access to swampy ground. If the sheep lose flesh and do not eat well, it is best to dispose of them, because there is no known cure for liverfluke. Uninfested sheep should be transferred to another pasture. *Scab* is a very serious disease of the skin of sheep and is caused by harboring a small mite in the pores of the skin. The wool falls from the back of the sheep, and scabs full of pus appear. This disease may be cured by treating the sheep with cresol dip or similar disinfectants. The *botfly* or grub causes serious trouble in the heads of sheep. The grub enters through the nose, causing a discharge of matter. The swelling and soreness may cause death. The animal often carries its head turned to one side. Treatment of the nose

with turpentine is effective. Pine tar applied to the nasal passages may help. Dipping sheep in disinfectants will destroy ticks and lice. *Foot-rot* is a decay of the feet of sheep, contracted while they are pasturing in swampy places, and removal to higher ground is advisable.

Breeds. Long selection of different kinds of sheep has developed two distinct types as widely different as beef

FIG. 85. *A Cheviot; note the distinctive ears and the Roman nose of this large mountain sheep originally from the Cheviot Hills*

and dairy cattle. *Mutton sheep* are those heavy, square animals grown for the quantity and quality of their meat as well as for their wool. They include the *Shropshire*, *Southdown*, *Hampshire*, *Cotswold*, *Lincoln*, *Dorset*, *Oxford*. *Leicester*, and *Cheviot*. These breeds originated in England,

in counties for which the various breeds have been named. The majority of mutton sheep are black faced, but the Lincolns, Cheviots, and Leicesters are white faced. Perhaps the Lincolns are the largest breed, but the Shropshires are most popular in America. The *wool type* is usually much more angular. The strands of wool are long and fine. Mutton breeds produce a medium or coarse wool. *Merinos*, *Delaine Merinos*, and *Rambouillets* are the wool breeds. Most of these originated in Spain and France, but many changes have been made in their general characteristics.

FIG. 86. *A Lincoln; note his sturdy mutton qualities, also his characteristic long, coarse, and curly wool*

They are well adapted to the mountainous regions and plains. For the Corn Belt farmers a medium breed of sheep producing wool and mutton is most profitable.

Selecting sheep. The loose covering of wool hides the defects of the body of a sheep. It is necessary to handle

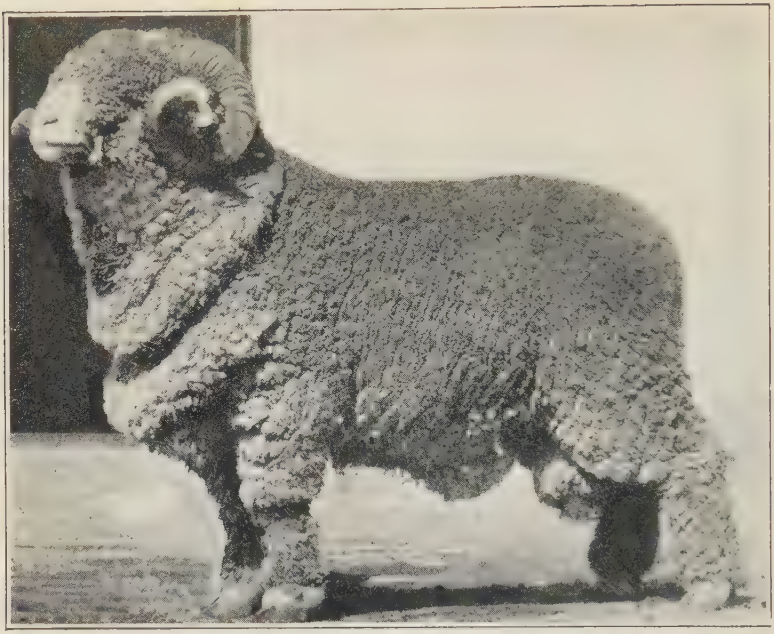

FIG. 87. *A Merino, with wrinkles and horns*

the animals to determine the amount of flesh and something of the weight. Whether sheep are for feeding or breeding purposes, they should have bright, clear eyes. They should have no discharge from the nose or wheezing. If sheep are losing wool, there is probably something wrong with them. Those with long legs and long necks seldom fatten well. Tags behind indicate digestive troubles and a doubtful state of health. In handling sheep to determine the amount of flesh, they are usually seized by the wool just over the loin. The legs and flanks may be handled quickly. By carefully parting the wool over the shoulder, the skin may be observed. If it is pink and pliable, the animal may be considered a desirable feeder. Feeder sheep should have a strong constitution, a wide, deep chest, and well-sprung ribs, also a well-developed barrel. The latter indicates good capacity for feed.

GOATS

Goats are used for many purposes. Jokes have been directed in various forms at the innocent-appearing animal which is so much like a sheep and yet so different. One

FIG. 88. *This is not a milk goat, but he heads a herd of White Saanen milk goats*

of the most common of these is the rather slangy expression "getting your goat," meaning, perhaps, to cause embarrassment. Riding the goat is still a much-discussed subject. The curious habit of goats in eating everything within reach has caused many boys to consider them destructive, troublesome creatures. While all of this is true, goats have been of considerable value in the trend of civilization, from the time of Abraham and Isaac to the present. They are raised for their milk, meat, hides, and hair. In some countries goats' milk is regularly used as food and is preferred to cows' milk. It is especially valuable for feeding infants and invalids. Tuberculosis germs

are not known to be carried in the milk of goats. The meat of goats is seldom sold as such, but usually butchers sell it as mutton. The pelts are made into capes, muffs, and rugs. Such articles as gloves, shoes, and soft leather goods are manufactured from the inner layer of the skin, known as "kid." Genuine Morocco and Cordova leather goods are made from goatskin. Fine shawls are made from the hair of the Cashmere goat, and mohair, from the Angora, is used for making cloth for clothing and plush for railway cars. Boys like goats for pets, farmers need them to eat down the underbrush, and sheep raisers use them as leaders, scouts, and fighters for their flocks.

The number of goats. Mountainous regions of Europe and Asia are the most important homes of domestic goats. There are 3,563,659 goats in the United States, according to a recent census. Most of them are to be found in the states of Texas, New Mexico, Arizona, California, Oregon, Arkansas, Missouri, Mississippi, Michigan, Wisconsin, and New York.

Kinds of goats. Our present varieties of goats probably originated from the Persian *pasang*, a wild goat of Persia. These hollow-horned ruminants resemble sheep to some extent. They are ill-shaped and ugly. Their tails are short, and they have fine, strong silky hair.

Angora goats were imported into the United States as early as 1849 from Turkey. They have long, fine white hair reaching a length of six or eight inches. Fleeces weigh from two to five pounds. Young goats produce a higher quality of hair than older animals. The young kids are allowed to suckle their mothers until they are four or five months old.

Milk goats. Farmers of ordinary means are not extensively interested in milk goats. Their use is limited to the wealthy people near large cities who keep the goats to provide milk for their children. Hospitals also keep herds for

providing desirable milk for sick people. Most of our milk goats originated in Switzerland. Toggenburg and White Saanen breeds of goats came from valleys in Switzerland bearing those names. High prices have been paid for the best breeding stock. A Chicago millionaire paid $6,500 for

FIG. 89. *An Angora, with overcoat and whiskers*

one goat. One gallon of milk each day is a fair production. While goats' milk can be used for drinking and cooking the same as cows' milk, it is less satisfactory for the making of butter. Considerable goats'-milk cheese is made.

Feeding and shelter. While goats can hardly thrive upon a diet of tin cans, they do not require a large quantity of expensive feed. Shrubbery for browsing and waste pastures are the most satisfactory. It has been noted that goats thrive best in a hilly, dry region. Shade and protection from cold rains are quite important. A sloping shed along a hillside is perhaps the best shelter. It has been observed that goats prefer companionship, and it is best to keep five or six together.

QUESTIONS

1. Why should farmers raise a few sheep?
2. What are three objections to keeping sheep upon farms?
3. Name six breeds of sheep.
4. Why is it important to change the feed and pasture for sheep?
5. What advantage is there in raising winter lambs?
6. How much wool is obtained from an ordinary sheep?
7. Name three common diseases of sheep; suggest a remedy for each.
8. What points are to be considered in selecting sheep?
9. For what purposes are goats raised?
10. Tell of the origin of the domestic goat.
11. Of what value are Angora goats?
12. Name the two important breeds of milk goats.

PROJECT LESSON

Exercise I

Object. To learn the various qualities of sheep.

Materials. Notebooks, a convenient flock of sheep, and score sheets.

Procedure. Two students may work together. Select a desirable type of sheep and score the respective points as compared with a perfect type.

Animal........................	Date........................
Student........................	Standing........................
Age: Estimated................	Actual........................

Scale of Points	Possible Score	Student's Score
General Appearance (27 points)		
Weight, estimated —— score according to age........................	6	....
Form: low, broad, medium length, symmetrical, compact, standing squarely on legs........................	9	....
Quality: clean bone, fine skin, silky hair, clean-cut features........................	6	....
Condition: thick, even, firm covering of flesh, especially in regions of valuable cuts, indicating finish..........	6	....
Head and Neck (9 points)		
Muzzle: fair size, nostrils large, lips thin, mouth large....	2	....
Eyes: full, bright........................	1	....
Face: short, broad........................	1	....
Head: broad........................	1	....
Ears: well carried, fine........................	1	....
Neck: thick, short, throat clean........................	3	....

Scale of Points	Possible Score	Student's Score
Fore Quarters (11 points)		
Shoulder veins: smooth, full	2	....
Shoulders: smoothly covered with firm flesh, snug and well covered on top	4	....
Brisket: broad, full, breast wide	2	....
Legs: straight, short, wide apart, strong, forearm full, shank smooth	3	....
Body (20 points)		
Chest: deep, broad, girth large	4	....
Back: straight, wide, medium length, thickly, evenly, and firmly fleshed	5	....
Loin: broad, strongly, evenly, and firmly fleshed	5	....
Ribs: deep, well sprung, evenly and firmly fleshed	4	....
Flank: low, thick, making underline straight	2	....
Hind Quarters (19 points)		
Hips: smooth, medium width	3	....
Rump: long, level, width well carried back, evenly and firmly fleshed	5	....
Thighs: full, well fleshed	3	....
Twist: deep, plump	5	....
Legs: straight, short, strong	3	....
Wool and Skin (14 points)		
Quality of wool: long, dense, even, well distributed over body	4	....
Quality of wool: fine, soft, pure, even	4	....
Condition of wool: bright, strong, clean, yolk abundant	3	....
Skin: pink, clear	3	....
Total	100	....

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CHAPTER XIII

POULTRY

Poultry raising is now one of the leading agricultural enterprises of this country, and, according to the 1923 estimates of the United States Department of Agriculture, the value of poultry products produced yearly is exceeded only by four other farm products — dairy products, corn, cotton, and swine. The increasing demand for high-grade poultry products offers every promise that the industry will continue to develop and maintain itself as one of the leading activities of American agriculture.

Kinds of poultry. Poultry includes turkeys, ducks, geese, guineas, pheasants, peafowls, ostriches, swans, and chickens. However, according to the 1920 United States Census report, the value of chickens was fifteen times that of all other kinds of poultry. The other kinds of poultry named in the order of their importance are turkeys, geese, ducks, and guineas.

Poultry products. The primary poultry products are eggs and meat, the value of the eggs being greater than that of the meat. Since about half the eggs are produced between March 1 and July 1, large numbers are placed in cold storage then, when prices are lower, and held for sale when eggs are scarce and command a higher price. In like manner the broiler supply is marketed by producers mainly during June, July, and August. In order to take care of the supply, many are put into cold storage so the trade demand can be supplied throughout the year.

Baby chicks. Perhaps the greatest recent poultry development has been the hatchery for producing baby chicks. While this development has centered in Ohio, the growth

of this phase of the industry has been so rapid that the day-old chick is an available commodity in nearly every community in the country. The hatchery has been one of the important factors responsible for the rapid progress recently made by the poultry industry.

The chickery. Another new development which offers great promise for future growth is the production of pullets for sale, instead of the day-old chicks. Now that the hatchery is well established, the next logical development seems to be the chickery, where chicks will be reared in large numbers by a specialist who will have at his command all equipment that can be used effectively in the brooding of chicks. In other words, the chickery would be equipped so as to handle the brooding of chicks with the same efficiency as the modern hatchery handles the hatching problem. With a modern brooder house thoroughly equipped in every way, including a central heating plant, a specialist and one helper can brood thousands of chicks with a minimum expenditure of labor. Poultry keepers, as a rule, buy baby chicks, because pullets of the kinds desired are not usually available. The chick may be regarded as a raw product, whereas the pullet is the finished product. The latter is generally desired, and there is a ready demand for high-grade pullets at a satisfactory price.

Breeds and varieties of chickens. There are two general classes of chickens — the light or Mediterranean breeds kept more generally for egg production, and the heavier breeds which are better adapted for meat purposes, although they may prove equally satisfactory for egg production. The lighter breeds are better adapted for keeping in large numbers, while the heavier breeds are often more suitable for those keeping smaller flocks when both the eggs and meat are desired. Of the lighter breeds, the Single Comb White Leghorns are the most popular; and of the heavier breeds

FIG. 90. *The egg-producing type of chicken*

FIG. 91. *A hen of the meat-producing type*

the Plymouth Rocks, Rhode Island Reds, Wyandottes, and Orpingtons are the leading breeds. Beginners often ask, "Which is the best breed of chickens?" The breeds which the poultry keeper likes will give the greatest satisfaction, since there are a number of excellent kinds to choose from.

Housing and equipment. The first requirement in starting with poultry is shelter and equipment. These are essential for success. Rapid progress has been made along these lines. While there are many types of poultry houses which are satisfactory, only one will be described. The twenty-by-twenty multiple-unit adaptable poultry house is shown in Figures 92 and 93. This house is of simple and economical construction. Plans of a house somewhat similar to this may be secured from your college of agriculture or experiment

FIG. 92. *Front view of multiple-unit poultry house*

FIG. 93. *Rear view of same house*

station. Briefly, this house is five feet high in the rear, eight feet high in front, and twenty feet wide, with partitions every twenty feet of its length. There are single sash windows under dropping boards directly opposite the front windows.

Size of poultry house. The adaptable house can be made any length desired. One twenty-by-twenty unit will accommodate 120 of the lighter breeds or 100 of the heavier breeds. This allows three and one-half square feet per bird for the former and four for the latter. When a house for a small number is desired, the brooder house will serve the purpose. A twenty-by-forty foot house is very desirable because it provides ample range for a large flock, as well as room for partitioning.

A portable brooder house. The portable, rather than the permanently located, brooder house is preferred, so that the chicks may be raised in a different place each year, thus

FIG. 94. *This portable colony brooder house is preferable to a permanently located house. It also provides a home for pullets when they are growing*

avoiding diseases and parasites. A brooder house which has been very satisfactory for the purpose is shown in Figure 94.

Wall nests. A nest should be provided for every four or five hens. The wall nests shown in Figure 95 are built in sections of four nests. The lower section is supported by a spike or block on the wall or post, sixteen inches above

the floor, and hooked with a screen-door hook to the wall. The upper section is placed upon the top of this and hooked in like manner. Such nests are easily removed for cleaning and spraying. The bottoms are made of number six hardware cloth, and the nests are largely self-cleaning. They

FIG. 95. *A wall nest that is made like a sectional bookcase. Such a nest is easily removed for cleaning and spraying*

should be located where there is suitable wall space available rather than under the dropping boards as has been the practice in the past.

Dry-mash feeder. Since egg production depends largely on mash consumption, a suitable dry-mash feeder is of great importance. The essential points of a good feeder are that it be waste proof, roost proof, and dirt proof. The feed should be easily accessible and never clog. An abundance of light should be available on the feed when the birds are eating. To meet these requirements, an open-box type

of feeder is needed. In 1921 the reel mash feeder (Fig. 96) was designed by the Ohio Experiment Station. It meets the above requirements and has come into general use throughout the country. This feeder can easily be made at home, as the details of construction are fully evident from the photograph.

FIG. 96. *Details of construction of a reel mash feeder*

Water stand. Drinking equipment is of great importance. A fourteen-quart pail and stand similar to those shown in Figure 97 are highly satisfactory. Stands may be made to accommodate two pails, enough for 100 hens. The construction is simple and details are evident from the photograph.

The breeding flock. Much care should be used in selecting the breeders. Only the best birds in every respect should be used. A few well-selected breeders are preferable to a larger flock containing inferior birds. The breeder should represent the best in health, vigor, type, size, and color. Birds not true to standard type or color and undersized specimens should receive no consideration. Perhaps most important of all, birds that are not in the best state of health should not be permitted in the breeding flock if best results are to be secured. As the rooster is "half the flock," too much care cannot be exercised in his selection. He is the head of the flock and should be the finest, most robust obtainable, up to the size, of proper type and color. The birds should be mated one week before saving the eggs for hatching purposes. Likewise, the eggs may be used for hatching purposes one week after the rooster is removed.

FIG. 97. *Water stand for hens, with a pail of water*

One male should be provided for each fifteen or twenty hens of the lighter breeds, while twelve to fifteen females of the heavier breeds are enough for one rooster.

Incubation. The eggs for hatching should be stored in a cool (about 50° or 60° F.), dry place, and ought not be held longer than eight or ten days before setting. If the eggs are to be hatched in an incubator, it is usually best to follow the directions given by the manufacturer. If it is an incubator with no instructions, a set of directions may be secured by writing the manufacturer. In case it is desired to hatch by hens, it would be well to write the United States Department of Agriculture, Washington, D. C., for its bulletin on this subject.

Brooding the chicks. A standard coal-stove brooder of ample size and capacity in a ten-by-twelve colony house

which will accommodate 350 or 400 chicks makes a very dependable outfit, and is to be recommended in most cases. It is a decided advantage to build the house so it can be moved to a new location each year, in that this practice usually offers the best solution of the disease problem. The floor should be covered with about an inch of sand, planer shavings, chaff from clover or alfalfa, or chopped hay. Cut straw may be used, but it is the least desirable of the materials mentioned.

Feeding and drinking equipment. During the first two weeks of the life of the chicks, fountains are preferable for supplying water or milk to drink. Afterward the reel trough will be found more satisfactory, either for water or for milk. The reel is adjustable so that it can easily be lowered or raised according to the age and size of the chicks. Chicks will learn to eat dry feed if small quantities are placed on pie plates, egg flats, or newspapers five or six times daily. As soon as they have learned to eat, the open mash boxes (Fig. 98) are the most satisfactory until the chicks become four or five weeks of age, when the reel mash feeder can be used to advantage. A grid is placed over the open box.

FIG. 98. *An open mash box and wire netting covering, for use during first four or five weeks*

The feeding problem. Poultry feeding may be considered as a manufacturing process by which raw material is converted into finished products. The inedible materials are made into eggs and meat, which are edible foods. The feeding problem, then, is to secure the greatest quantity of high-quality finished product from the raw material at the

least cost. This does not mean the use of the cheapest foods, but rather the feeds that will yield the greatest return in the finished product. The cheapest feed is by no means the most economical.

A complete ration necessary. Whether one is feeding chicks or hens, a complete ration is required. Such a ration consists of five essential parts which are listed below. In the construction of a ration which will give the best results, all these factors must receive due consideration.

1. Grains and their by-products, such as corn, wheat, or oats, and bran.
2. A protein concentrate, such as milk, meat scraps, bone meal, or vegetable oil meals.
3. Minerals, as supplied by milk, meat scraps, bone meal, salt, oyster shells, and limestone grit.
4. Vitamins A and B, as supplied by yellow corn, green feed, or legume hays.
5. The anti-legweakness factor, sometimes called vitamin D. This factor is supplied principally by direct sunlight, cod-liver oil, or eggs.

Grains and their by-products. Corn, wheat, oats, and barley are the grains used most extensively in poultry feeding. While any of these grains make good feeds, corn and wheat are the most popular because chickens like these grains so well. Yellow corn is perhaps the most valuable, because, unlike other grains, it is a good source of vitamin A. The larger portion of the ration may be yellow corn, provided it is balanced by proteins and minerals. The principal by-products are wheat bran and middlings, and corn is the source of corn gluten meal and hominy feed. These are important products which enter into the preparation of ground feed mixtures, known as mashes.

Minerals. The use of minerals in addition to those found in the ordinary feeds is a comparatively new practice. Very

little attention has been given to this important part of the ration. The common sources of minerals are bone meal, ground limestone, oyster shells, and salt. Recent information on nutrition of chickens shows that it is better to have a surplus of minerals in the ration than to take any chance of a deficiency. Oyster shells should always be kept before the birds in suitable feeders, beginning when the chicks are in the brooder and continuing throughout their lives.

The anti-legweakness factor. This is sometimes called vitamin D, and is one of the latest discoveries in the nutrition of chickens. The sources of this factor are sunlight, cod-liver oil, and egg yolk. It is the factor which prevents rickets or legweakness, especially in the case of young chicks confined indoors without exposure to direct sunlight. Glass does not permit this vital factor to pass through, and it is direct sunlight that is so essential to chickens as well as to humans. It has been considered difficult to raise chickens indoors on account of legweakness, which appears when they are six or eight weeks old.

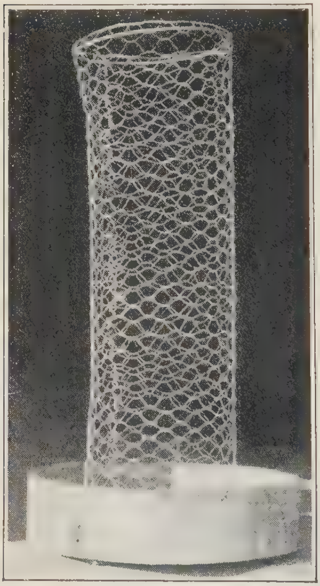

FIG. 99. *Wire-netting basket feeder for green feed*

Green feed. After September it is usually well to have cabbage to feed the birds. If the range becomes depleted earlier in the season, cabbage or other green feed should be fed as soon as the outdoor green feed becomes inadequate. A very effective substitute for green feed for winter feeding is alfalfa, clover, or soy-bean hay. The hay is usually chopped with a cutter and fed by means of a wire-netting

basket feeder (Fig. 99). The hay for this purpose should be as leafy and as well cured as possible.

Cod-liver oil has also proved a valuable supplement to rations for winter feeding and to rations for early-hatched chicks that are to be confined for more than a month. A

FIG. 100. *Hens relish clover hay as a substitute for green feed*

good grade of crude medicinal cod-liver oil contains a high concentration of vitamin A. It prevents legweakness, and seems to remedy poor shell texture when given to layers. The oil is used at the rate of 2 per cent of the mash by volume. This is equivalent to a quart of the oil to each 100 pounds of mash.

Culling poultry. Constant culling of chicks, pullets, and layers is required for most profitable results. No chick that offers poor promise of becoming a good bird when grown

should be permitted to remain in the flock, and no pullet should be retained which does not give promise of developing into a good layer at the proper age. Sick or deformed birds should always be removed as soon as detected.

The culling of the poor layers is usually best accomplished during August and September. Late molters are generally regarded as the best layers. In the case of yellow-skinned birds, the absence of yellow pigment in shanks, or bleached shanks, indicates the better layer, and yellow shanks designate the early molter which is to be culled. The plumage is also a valuable index of a hen's performance. If it is tattered and worn, showing signs of long, hard wear, it indicates a hard-working bird—the late molter and best layer; whereas the nice-looking, clean, fresh plumage indicates the early molter or the poor layer, to be culled.

By handling the hens, after a little practice it is a simple matter to select those which are laying at any given time. The layer has a soft, pliable, expanded abdomen, two or three finger spaces wide between the pelvic bones and the point of the keel bone. The vent is pink or flesh colored, expanded, and moist, while the nonlayer has a rather hard, firm, more or less contracted abdomen, one or two finger spaces between the pelvic bones. The layer is usually friendly as compared with the nonlayer, which is more inclined to be wild and nervous, squawking when caught.

The birds with full crops when they go to roost are generally the layers, while those having rather empty or partly filled crops are often not laying at the time. It should be remembered that some of the best layers take a vacation at different intervals, so that one should be careful about culling birds that do not happen to be laying at any particular time. After culling in August or September, a later selection should be made during the latter part of October for the late molters and those to be used for the breeding

flock the next spring. The breeders selected should be banded to be distinguished from other hens.

Culls are greatly increased by improper feeding. It is necessary to know how the flock has been fed and managed before culling can be done intelligently. Poor feeding often causes the otherwise good layers to molt early and be classed as culls in August and September. One of the best ways to reduce culls is to feed a well-balanced ration and provide an adequate range with green feed.

Chick troubles. Huddling or crowding is perhaps one of the most frequent difficulties encountered in the brooding of chicks in large numbers. There are different causes, among which are chilling, a brooder that is too hot, or something that frightens the chicks so that they will pile up in one corner of the brooder. The remedy is to remove the cause as far as possible. If the chicks crowd once, they often persist in it as a habit. Probably the best prevention is the use of a wire-netting frame. The roost formed by sloping this above the floor so that the chicks cannot get under it will provide a means of preventing serious crowding. The roosting habit is developed by this sloping frame.

Cannibalism. Toe, tail, or wing picking sometimes becomes a serious problem when chicks are confined indoors or are restricted to a small yard. The cause of cannibalism has been attributed to the lack of something in the ration — a craving for salt which they get in the blood, the need for fresh meat and other things. Careful observations, however, indicate the cause to be a vice or perverted habit or mischievousness which arises from close confinement, idleness, or overcrowding, regardless of the ration.

Bright sunlight on part of the floor sometimes causes chicks, especially the weak ones, to huddle in the light spots, and, as a result of the bright sunlight on their feet, they get started to picking each others' toes. Tail or wing picking

usually starts when the pin feathers are developing. These are full of blood and picking easily starts them to bleeding.

Prevention is mainly accomplished by keeping the chicks comfortable and busy. If the brooder room is kept comfortable and regular attention is given the chicks, they are less likely to contract the mischievous habit. Hunger, due to empty mash boxes, will cause an outbreak of cannibalism. Darkening the room is also an effective control.

Lice. Poultry losses often result from the attacks of lice. They do not seem to rob chickens of vitality so much as they irritate and cause nervousness. The sodium fluoride treatment is the only means for the eradication of lice that need be considered, as it seems to be far superior to any other treatment, both from the point of ease of application and from the economy of its use. There are two methods of application, dipping and powdering.

Mites. Since mites make their homes in the chicken house, particularly the roosting and nesting quarters, it is necessary to treat them there. This is accomplished by spraying the quarters with an oil of some kind, such as kerosene, crude oil thinned with kerosene, cresol, wood preserver, or the refuse oil from an auto crank case. This refuse oil may often be secured from a garage for little or no charge, and when thinned with kerosene is very satisfactory. Lime-sulphur spray, even though used in a concentrated form, is not very satisfactory. The roosting and nesting quarters should be thoroughly sprayed during May and September. If the coops are badly infested, it is well to spray each month during warm weather. New houses may require spraying but once a year, preferably in May.

The cracks and crevices about the roosting quarters are the favorite hiding places, especially the undersides of roosts and the points where they rest on the support and under splinters. The excrement of the mites, which somewhat

resembles "fly specks," is one of the first things to look for when examining a coop for the pests. The "specks" indicate the presence of mites at some time. The mites are little spiderlike creatures, just large enough to be seen with the naked eye. They may be almost colorless or quite red, depending upon whether they have lately extracted blood.

Marketing poultry products. As in many other lines of production, the rate of profit in poultry keeping is determined by the marketing. High-quality products encounter less competition than medium or low-grade products. For the individual producer, undoubtedly catering to a special trade offers the best opportunity for securing good prices. Many consumers desire quality products and are willing to pay for them. The way to secure such trade is to supply a uniformly high-grade product. Eggs should not only be strictly fresh, but up to size and candled for interior quality. Blood, meat, or liver spots are of rather common occurrence in fresh eggs. The only way to detect eggs with these defects is by candling. One cannot afford to allow eggs with blood spots or other defects to be delivered to the customers if better prices are being asked for quality. Eggs weighing less than two ounces are not of the first class. Eggs should be clean and stored in a cool dry place. The infertile, rather than the fertile, eggs are desired for the highest quality market eggs. Neat cardboard cartons, each containing one dozen eggs, make a desirable container for supplying special customers.

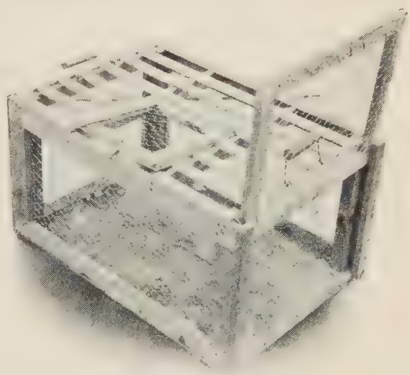

FIG. 101. *Poultry catching crate, with gate on each end and door at top*

QUESTIONS

1. How does the value of poultry compare with that of other farm products?
2. Why are eggs cheaper in April than they are in November?
3. What is meant by a chickery?
4. Name four breeds of chickens.
5. What do we mean by a multiple-unit poultry house?
6. What is the advantage of a portable house?
7. Do chickens eat more with a self-feeder than they do when fed by hand?
8. What is meant by a complete ration?
9. What are vitamins?
10. Why is cod-liver oil fed to chickens?
11. Mention three things to be observed in culling poultry.
12. What is cannibalism?
13. How may we get rid of lice and mites on poultry?
14. How do we candle eggs?

PROJECT LESSON

Exercise I

Make arrangements with your parents to take charge of and manage the home flock. Keep records of feed used, other expenses, and the income, such as the number of eggs produced.

Purchase a few pure-bred fowls and start a flock of your own.

Get an egg score card from your agricultural college and grade the eggs produced.

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CHAPTER XIV

RODENTS AND OTHER VERMIN

RODENTS

What rodents are. One-third of all the different kinds of four-footed beasts upon the face of the earth are rodents. Those animals which have sharp front teeth especially adapted for gnawing are rodents. These teeth are so sharp that they will gnaw almost any kind of material. They do not become dull with use, because the front has a very hard enamel and the back is soft, so the teeth are really self-sharpening. The rodents' food is usually herb and plant material, but some of them eat anything they can get.

The great family of rodents includes many of the well-known small animals — rats, mice, squirrels, rabbits, gophers, chipmunks, weasels, prairie dogs, muskrats, porcupines, and beavers. If you should have an opportunity to examine

FIG. 102. *Two rodents which cause much damage in fields (field rat and gopher)*

any of these creatures, you will observe that each has two sharp front teeth projecting out of his mouth quite prominently.

Where rodents live. The reason there are so many rodents in the world is that they are able to live in almost any kind of home. Some of them thrive in the coldest regions of the Far North. Others live in the hot jungles near the

Equator and in the deserts. Many rodents build their houses under the ground. Beavers and muskrats like to have their homes surrounded by water, even if they have to build islands upon which to construct them. Squirrels build nests high up in the trees.

Not all these animals may be found in every community, but we may say that wherever man lives you will find two very well-known rodents, rats and mice.

Rats, they fought the dogs. The big gray rat that goes sniffing about at night represents a rodent group that has always been a pest to humanity. His ancestors have carried plagues and diseases from the earliest times. The "plague" is caused by germs which may be carried by fleas upon the rats. Twenty-five millions of people died as a result of the plague, probably carried by rats, during the "Black Death" of the fourteenth century. At about that time the famous Pied Piper of Hamelin is said to have done his wonderful work. While he did indeed rid one or two places of rats, there is every evidence that a multitude have survived. Crowded cities have them, and nearly every farm is infested to some extent. It has been noted that rats travel according to seasons. They seem to spend their summers in the country, but return to the warm buildings in town during the winter.

FIG. 103. *A rat with teeth. He is not praying*

These rodents are not only harmful in that they carry diseases, but their destruction of food is appalling. Every grocery store and wareroom has a rat population in proportion to its size. Cities are said to have as many rats

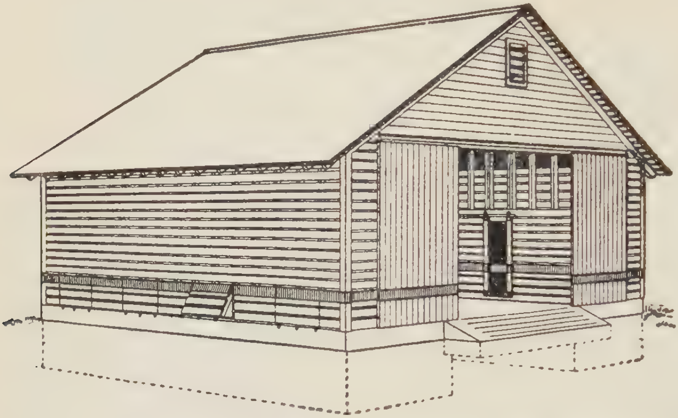
as they have people. The rural rat population is even greater. A conservative estimate would show that rats damage and spoil more grain throughout the world than is required to feed our entire American nation of one hundred millions of people. They not only destroy grain, but small chickens and eggs are carried away by the voracious creatures.

Doing away with the rat apartment house. Owing to the migratory habits of the rat, country and city people should work together in exterminating the pests. It is important that everybody in the community enter into the various plans for preventing rats from nesting in buildings. It is not impossible to make all buildings rat proof by building concrete and brick foundations. Wire nettings and screens are often used about windows and frame buildings to prevent rats from gnawing through. Such slight precautions are inexpensive and will be effective for years.

Disposing of the rat cafeteria. Perhaps a still more effective method of exterminating the rodents is to remove their food supply. If rats cannot get food, they will leave. City people have solved the problem very well by providing covered garbage cans and by rat-proofing stores. Farmers have a very difficult task, because grain and all kinds of food which a rat relishes are grown in the fields. Fodder shocks make excellent cafeterias for rats and mice. It is not uncommon to find a large rat den under a shock of corn, with most of the grain badly damaged. Hay and grain stored in the same building provide a regular rat hotel — a nice warm place to sleep and a cafeteria of the most convenient type. In this case it is more of a problem to destroy the rat population.

Means of fighting rats. Professional rodent exterminators have been employed in cities to prevent the destructive work of rats and mice about large stores. Their methods and

those of the Biological Survey of the United States Department of Agriculture are perhaps the most effective in fighting rodents. The rat-proofing of all buildings where grain is



Courtesy United States Department of Agriculture

FIG. 104. *A rat-proof corncrib showing the outline of the concrete foundation and a metal strip round the base of the crib*

stored will enable farmers to prevent rats from gaining a foothold. Traps, baited with some food not usually obtained by the rats, will catch many. There are many kinds of traps. Heavy spring traps are inexpensive. Cage traps are safer where there are other animals. A barrel half filled with water and covered with a sort of trapdoor will catch dozens of them during dry weather (Fig. 105).

Poisons should be used with caution. Arsenic and strychnine mixed with various foods are the common rat poisons. They are objectionable because the rats die in the buildings. Phosphorus is an effective poison, but it may cause fires. Barium carbonate is one of the most desirable rat poisons because the rats seldom die in the buildings. It is a slow poison, allowing them time to escape. Gas poisoning by means of gas forced into the holes occupied by the rodents is common. Chlorine has been used. The

exhaust from an automobile, forced down into a rat hole, will destroy a whole colony. Calcium cyanide placed at the mouth of a hole and covered with earth will kill rats

Courtesy United States Department of Agriculture

FIG. 105. *The barrel trap for rats*

1 — With stiff paper cover
2 — With hinged barrel cover

a — Stop
b — Baits

and all other animals breathing the gas. It is quite important that these poisons be placed where chickens and other animals will not be poisoned.

Cats and dogs aid in destroying rodents. A vigorous young fox terrier will justify his existence by killing rats. Some cats may catch rats, but most of them are afraid of large rodents. It has been suggested by the Biological Survey that owls and hawks destroy more rats than do cats and dogs. Recent information indicates that the hawks and owls do much more good than harm.

All of the above methods should be followed by the whole community to exterminate rats. These may be summarized as follows:

1. Construct rat-proof buildings and granaries.
2. Store grain, food, and garbage in places which the rats cannot reach.
3. Protect the hawks and owls, natural enemies of rats.

4. Use poisons judiciously.
5. Build traps of various kinds.
6. Organize a rat campaign involving the city and country people.

Mice, the lesser evil. When the famous Scottish poet, Robert Burns, wrote those well-known lines,

> Wee, sleekit, cow'rin', tim'rous beastie;
> O, what a panic's in thy breastie!

he was probably not thinking of those hordes of mice which inhabit storerooms and granaries. He saw only one innocent creature that had been turned out by the plow. The fact that a mouse is timid and small enables him to escape the ordinary enemies and thrive where rats cannot live. Both rats and mice belong to the same group of rodents, but the latter are so small that they may elude the ordinary observer. When food is plentiful, mice multiply so rapidly that great damage is done before they are noticed.

Mouse destruction. Some boys have solved the problem of catching mice, because they have learned that mice may be seized by the back of the neck and held so they cannot bite. Cats also practice this method of holding them. However, both are inclined to neglect their duties when there are hundreds of mice. The rodents work at night, so that it is necessary to get some other means of controlling them. A number of guillotine traps will catch them about buildings. Poisons may be used if proper precautions are taken. Mouse-proofing of buildings may be practiced along with rat-proofing.

Field mice, those short-tailed, brown rodents which infest fields and orchards, are a more serious problem in many communities. They burrow into the ground and eat the roots of many plants. In the winter they have a very destructive habit of gnawing the bark away from the bases

of apple trees. Whole orchards of young trees have been killed by them. Cultivation of the soil and poisoning are perhaps the best methods of eliminating them.

OTHER VERMIN

Cockroaches in the cupboard. If you should meet a cockroach and he could speak the language which you speak, he might be able to tell you a very interesting story about his travels. Some of the facts might be so repulsive that you would feel inclined to crush him before he had finished. He would probably tell you that his home is in a dark corner of the cabinet or just under the floor. He comes out at night, feeling his way very cautiously with his long whiskers. He is not a rodent, as are rats and mice, but an insect. He has six legs, is brown or black, and has a hard glossy shell. In addition to his legs, he has wings with which to fly. He would no doubt explain that he drank water from the filth of the drain pipe or from the garbage can. He then goes to the cupboard for various articles of food, usually beginning with the dainty bits of angel-food cake and tasting even jelly or syrup. We would not object so seriously to such actions if Mr. Cockroach would be more careful with his feet. In walking through the garbage can he collects thousands of germs. These are carried upon his feet and distributed over the cake and pie. Diseases may be spread and a great quantity of food may be spoiled.

The difficult part of cockroach eradication is that the insect reproduces very rapidly and is not easily reached. At a small cost many insect powders may be obtained which give off poisonous gases. These will probably kill the roach as effectively as anything. Cleanliness is the best means of preventing roaches. If they cannot obtain food, they leave.

Flies from the gutter. The common housefly is such an innocent appearing scoundrel that you would hardly suspect

him of having spent the night in a gutter or in a garbage can. Like many other tramps, he looks for a warm place to sleep during cold nights. This may be in a sewer or in a manure pile. When he awakes in the morning he does not wash his face or take a bath. He goes immediately to search for food in the nearest house. Instead of asking the good housewife for something to eat, the fly quietly slips into the pantry and looks for food that suits his appetite. He is especially fond of sweet things and fruit. Like the roach, he forgets all about cleaning his feet, and thousands of bacteria are distributed over the cake and pie. His filthy body may carry typhoid and a dozen other diseases. He does not hesitate to walk about the edge of a glass of milk. It is not uncommon to see him fall into the milk. Many unthinking mothers just dip out the fly with a spoon, and let the children drink the milk with all the germs. Tuberculosis has often been traced to infection from food contaminated by flies. When we see flies swarming about the mouth of a sleeping baby, we are reminded of the fact that it is time to take some steps to destroy them.

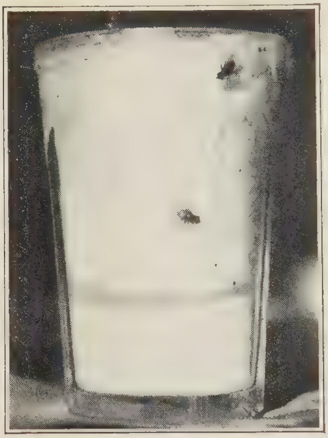


FIG. 106. *A glass of milk with flies walking about it*

"Shoo fly" and other flies. In order to get rid of flies it is very important that we know where they live and something of their methods of increasing. The eggs are deposited in decayed matter of all sorts, including garbage, decayed meats, and manure. These eggs hatch, after three or four days, into little white worms, often called maggots. By carefully watching these for several days, one may observe that

they change into brown, egglike structures known as pupa. These dormant forms hatch into adult flies which may again lay more eggs. Adults produce more than one hundred eggs, so that one fly, at the beginning of the summer, may be the progenitor of a million by the first of September. The slogan should then be, "Swat the Fly."

If we prevent the laying of eggs and kill all the adults, the fly population will be reduced. Stables are the most common source of fly incubation. The removal of manure and the spreading of lime in stables should become a practice wherever cattle and horses are kept in barns. Farm garbage usually goes by the name of "slop," and should be fed to hogs or buried as soon as possible. The time-honored "swill barrel" has been found unnecessary for profitable pork production, and it should not be tolerated, because it is a feeding and breeding place for flies. Poisoning is not usually advisable on farms where there are animals that might consume the fly poison.

Following are some suggestions for the prevention and eradication of the house fly:

1. Keep stables and surroundings clean.
2. Place manure under cover or haul it to the field.
3. Screen windows and doors.
4. Swat the flies in the house and put out fly paper.
5. Use fly traps.

Relatives of the fly. Smaller than the house fly is the little black *stable fly*. He is usually found biting cattle just behind the shoulders. He is also an annoyance to horses. We may free animals of the stable fly by using offensive insect powders in the stables.

Botflies are a source of trouble among sheep and horses. They are recognized as beelike flies, singing about the heads of animals during warm summer days. They lay eggs upon the hairs about the legs of the animal. When these eggs

hatch, they produce larvae which may be swallowed by the horses, causing bot infection of the stomach. They live in the stomach of the horse until the next spring. The sheep bot infects the nostrils and head of the animal, often causing death.

Ox warbles are found as small lumps in the backs of cows in May or June. By squeezing, a putrid mass may be forced out of the lump. They are often a source of trouble and destroy the value of the cowhide for leather. Stabling the cattle during extremely hot days of summer and killing the larvae in the "warbles" during the months of May and June will prevent serious injury.

Weevils and moths. Damages to grain crops do not end with enemies in the field. Innocent appearing insects, such as weevils and butterfly-like moths, fly about the ripening grain, laying eggs. These are usually deposited within the seed coats of the grain, and hatch into larvae after the grain has been put into bins. The heating of the grain aids in the incubation. The small worms feed upon the contents of the grain, destroying all but the outer shell. After a long dormant period the adult may hatch to lay eggs again the next year. A gas attack is the best way of destroying the larvae of these insects. Carbon disulphide produces a heavy vapor which settles into the bin or granary. By spraying the upper surface of the grain at the rate of one and one-half pounds of carbon disulphide to each ton of grain and covering the grain with canvas, the insects may be killed. Several applications at periods of four weeks may be necessary to kill all of them.

QUESTIONS

1. What is a rodent?
2. Name four familiar rodents.
3. Why are rats harmful to us?
4. Make a list of things that rats destroy.
5. Why is it difficult to exterminate rats?

6. Where and what do rats eat?
7. Where do rats make their homes?
8. Suggest methods of doing away with places where rats live.
9. How would you destroy mice in the home?
10. Tell how to eradicate cockroaches.
11. Tell about the various stages in the life of a house fly.
12. How would you destroy weevils, moths, and flies?

PROJECT LESSONS

Exercise I

Object. To study rats and mice.

Materials. Traps, bait, rats, and mice.

Procedure. The amount of damage done upon each farm should be estimated by examination of the granaries and barns. If it is found that the whole community is suffering losses from rats, a plan for concerted action should be developed by the class. Traps may be made from wire netting. Barium carbonate may be purchased from a drug store. A small quantity should be mixed with moistened grain, a tablespoonful to each pound of grain. A supply of this mixture distributed about the rat holes and runs will provide a very effective start. Fresh meat powdered with the poison attracts rats. It is important to place the poison where chickens and cats or dogs cannot eat it. A premium offered to the boy obtaining the largest number of rat tails will stimulate interest.

Exercise II

Object. Insect control.

Materials. Bottles with cotton stoppers, fly traps, carbon disulphide, grain with weevil.

Procedure. Collect two cockroaches in a wide-mouthed bottle and plug the bottle with cotton. Do the same with house flies. Observe them after introducing various kinds of food into the bottles. What do they like best? In this way determine what to feed them, and make plans for destroying these insects during the summer. Experiment with carbon disulphide as a means of destroying weevil and moths in bottles of grain.

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CHAPTER XV

KEEPING FARM RECORDS

Why farmers need to keep records. Why do men in any kind of business need to keep records? In 1920 there was a valuation of more than seventy-six billion dollars placed upon farm property; more than the value of any other one industry in the world. The farmers of the United States had borrowed more than four billion dollars, enough to buy an entire railroad system. Think of the enormous value of crops and live stock produced each year upon farms. Thousands of tons of steel go into our farming implements, thousands of millions of dollars worth of manufactured products are sold to farmers annually. It would be very expensive to employ an army of bookkeepers and accountants to keep a record of the farming industry. Besides, the individual farmer would not know whether those enormous figures referred to his farm or to some other farm. The system would be impractical because it would not permit the individual to keep a close account of his business.

Individual records. A farmer needs to know what he has upon the farm. It is true that most farmers do know how many hogs, cattle, and horses they own, but they probably do not know how many they had at the corresponding time last year or five years ago. An inventory should be taken at the beginning of each year, in order to compare the present farm values with those of several years past. Is there any room for improvement? How much money was taken in last year? Was the expense greater than the income? How much did the farmer receive for his labor? Was there any increase in crops over last year? What improvements may be made so that the farm will pay better next year?

The farmer often needs to borrow money to improve his business. He goes to a banker who immediately asks him what security he can offer. The farmer explains that his farm is right next to a farm that sold for one hundred dollars per acre three weeks ago. The loan is allowed upon the probable value of the land, and not upon the income of the farm. It would be much more satisfactory to the banker and to the farmer if they could take a map of the farm showing how much each field produced last year, how much live stock was fed, and the gain from selling the animals.

Kinds of records. The records kept by farmers may vary from the simplest marking upon the barn door to a complete system of bookkeeping. Farm boys may learn the simpler methods of keeping records by beginning with a report of a club project. These small records in the form of folders include the cost of preparation, number of hours of labor, number of hours with a team, cultivation of the crop, and cost of harvesting the crop. Records of live-stock projects include the original cost of the animal, the cost of feeding, time required, and profits. Farmers may obtain a similar record book for their farms covering the entire year's work. These books contain a page for drawing a map of the farm. It is well to draw this map, locating the buildings, lots, and the fields where certain crops were grown. The map will serve as a record for working out crop rotations in the future.

An inventory, or property valuation, of the farm should be taken. Estimate the value of the land, buildings, and fences. The live stock should be listed at average market prices, and the increase or decrease over last year noted. Farm implements should be listed, allowing an average depreciation of 10 per cent of the original cost for each year. A mower five years old is usually listed at about two-thirds of its original cost.

Find the strong and weak places in your farm business by comparing your farm with the standard given below. Your profits depend largely on how good your farm is in the five conditions listed. Try to improve where you are weak.

(Find directions for figuring these factors on pages 46 and 47)

	Your Farm	A GOOD STANDARD
1. SIZE OF BUSINESS		
Acres in farm[1]	....	Approximately "two-man" size. 120 acres or more for general farming. Not as much needed for intensive farming such as trucking, fruit raising, poultrying, etc. (State average, 102.5.)
Acres in crops[2]		85 or more for general farming. Not as much needed for intensive crops. State average, 62.)
Productive man work units[3]	....	400 or more.
2. AMOUNT OF LIVESTOCK		
Number of productive animal units[4]	....	Average for state is 12.
Productive animal units per 10 A. land[5]	....	1.3 to 2.5 desirable. (State average, 1.25.)
3. RETURNS FROM LIVESTOCK		
Livestock receipts per animal unit[6]	$	$80 or more
Livestock receipts per $1.00 feed fed[7]	$	$1.40 or more.
Milk receipts per cow per year	$	$75.04 average of 5,649 cows in cow testing associations up to 1922. ($62 average for state according to 1920 census.)
Pounds milk per cow per year	.... pounds	6,365 average of cows in cow testing associations. (3,044 average for state according to 1920 census.)
Pounds butterfat per cow per year	.... pounds	268 average of cows in cow testing associations.
Live pigs per sow per litter	....	7.7 average of 565 sows on 57 farms spring of 1922.
Weight of spring pigs at 6 months	.... pounds	180 to 200 pounds.
Pounds wool per sheep	.... pounds	8 pounds.
Number of lambs per ewe	....	1¼.
Steer gain per head per day fed	.... pounds	1.5 to 2 pounds.
Eggs per hen per year	....	114 average of 30,490 hens on 267 farms in 1921 egg-laying contest
4. LABOR EFFICIENCY		
Crop acres per workman[8]	....	60 or more (unless on intensive farm)
Productive animal units per workman[9]	....	12.
Crop acres per work horse[10]	....	18 or more (unless on intensive farm)
Productive man work units per man[11]	....	200 or more.
5. CROP YIELDS		
Corn	bu	36.4 bu.—10 year state average
Silage	tons	7 tons
Oats	bu	34.6 bu.—10 year state average
Wheat	bu	15.4 bu.—10 " " "
Barley	bu	28 bu.—10 " " "
Rye	bu	14.9 bu.—10 " " "
Hay	tons	1.27 tons—10 " " "
Potatoes	bu	76 bu.—10 " " "

(Average yields for your county for the year can be obtained from the Department of Agricultural Statistics, Purdue University, Lafayette, Ind.)

Fig. 107. *Page from a farm record book*

INDIANA

Farm Record Book

INDEX

RECORD OF FARM BUSINESS OF ____________

POST OFFICE ____________ COUNTY ____________

For the Year Beginning ____________ 192__

For information regarding this book write to Department of Agricultural Extension, Purdue University, Lafayette, Ind.

FIG. 108. *Another page from a farm record book*

Feeds and supplies include grains, hay, fodder, silage, and root crops. The quantity of food and materials which may aid in the family living should also be noted. A total of these various lists above should give a very accurate summary of the farm value.

Farm receipts include all the money taken in for crops, live stock, and miscellaneous sales. The last includes the sale of timber, labor with teams, woodland pasture, rentals, and other items not considered with crops. The farm expenses include the cost of labor, feed, seed, new buildings, repairs, new machinery, stock purchased, and miscellaneous expenses. The labor charges should include those of men and teams. If the farmer does his own work, it is well to make an estimate of the number of hours he worked each day to learn how much time was spent without pay. The amount usually charged for teams or tractors should be charged for all work of that kind done upon the farm by horse or mechanical power. These two items are often overlooked by farmers, and many profits would become losses if labor were considered at the ordinary price paid farm hands. If there is not sufficient pay for the labor, perhaps the farmer should look for a reason. There may be something wrong with his methods. Feed accounts may be kept easily if larger quantities of grain or hay are weighed or estimated at one time. Most farmers know the capacities of their cribs and mows. If the cost of feeding work animals is greater than the returns, some change should be made in the work. If there are any profits accumulated from operating the farm, a certain percentage should go to permanent improvements and repairs.

Other records include the weather, breeding of animals, the markets, and crops. It is interesting to know the extreme temperature, rainfall, and sunshine during a year. High and low markets are reported for live stock and grains

in most newspapers. A comparison and study of these variations will often aid farmers in selling crops at the time when there is the greatest demand. The question may arise, "When is the farmer to have time to keep all these records?" It does not require more than a few minutes each day to note the time spent and the amount expended for each kind of work. It has been stated by leading business men that too many farmers spend their time at useless labor without stopping to plan for the future. Newspapers contain the market page and may be clipped so that all the market prices may be filed. During the winter there will be many days when farmers may go over these records and work out an effective plan for the next year. A farm scrapbook would be of interest. The filed market reports provide extensive opportunities for study. Maps of the farm with various kinds of colored pins make an interesting method of recording the amount of work done in a certain field and in marking the progress in handling a crop.

QUESTIONS

1. Give three reasons for keeping farm records.
2. Why is it important to compare the records of this year with those of last year?
3. What may be learned by keeping club records?
4. What is meant by an inventory?
5. What are the average incomes from farms in your community?
6. How would you determine the value of the work of a team?
7. What advantage is there in keeping records of the weather and markets?
8. What are some good methods of filing records?

PROJECT LESSON

Exercise I

Object. To learn a simple method of keeping a record.

Materials. A standard farm record book and pencil.

Procedure. Obtain from your agricultural college farm management department or from your bank a standard farm record book. This book contains spaces for recording all the information suggested in this chapter. Draw a map of the farm upon which you live or some other with which you are familiar. Take an inventory of the property, as suggested in the blank. Get a record, if possible, of the receipts and expenditures for one year. Each member of the class should complete a record. Compare these records to see if there is a possibility of improving the farming system.

REFERENCES

BAILEY, L. H. *Cyclopedia of American Agriculture.* The Macmillan Company.

WARREN, G. F. *Farm Management.* The Macmillan Company.

CHAPTER XVI

MARKETING

The ancient Babylonians boasted that among the old families of their country there were many who neither bought nor sold. Their estates were self-sufficing. Everything that was consumed or used on the farm was raised or made at home. They did not have the wide range in choice of things to eat, wear, and use that the farm family has today. On the other hand, they did not have to worry about the problems of marketing the surplus crops and live stock or about buying supplies. Those conditions existed in early times, and in certain parts of the world today, even in the remote communities of the United States, a near approach to self-sufficiency may still be found.

The development of markets. The marketing of agricultural products became more and more difficult and complex as the population increased and as people congregated in large cities. If every cultivator of the soil raised and made all the products that he needed, and only as much as he needed, there would be no marketing problem. There was a time when all the people in the United States were engaged in producing food and in providing shelter. With the development of industry and machinery, such as the steam engine, the gas engine, and, later, electrical power, the manufacturing industries have assembled in large cities until today over two-thirds of the people in the United States live in towns and have to buy their food and clothing. In Ohio, which we think of as a great agricultural state, 80 per cent of the people live in towns and cities. New York, with its six million people, and Chicago, with its three million people, must be fed and clothed.

There are six times as many people in New York City as there are on all the farms in Ohio. The transportation and distribution of the products of the farm to this large city population is a problem.

The development of transportation. Formerly it was not possible for our cities to become very large unless they were located on the seacoast, or at least along a river where food could be brought in by boat. It would certainly not be possible to feed a large city such as Pittsburgh or Cleveland if it were necessary to bring in all the supplies by wagon. For this reason the early cities were located on waterways. With the development of railroads, after 1850, it became possible to ship supplies for a long distance overland. The railroads opened the West to profitable farming. They furnished an outlet for the surplus products. At the same time they allowed the cities to grow, for they made it possible for the cities to gather their food from long distances. The building of good roads and the coming of the automobile and truck in comparatively recent times have caused many changes in the marketing of farm products, as they have made it possible to extend the area which is tributary to a market. Today it is no longer necessary that food for a city be produced near by. Nor is it necessary that a farm be near a city to find a market for its products. Cheap transportation has made it possible to ship for long distances.

Specialization in production. In the early days when there was little market for surplus farm products, and when, because of the high cost of transportation, it was necessary to sell to a near-by market, the farmer found it best to produce a little of everything without regard to the quality of his land. Cheap and rapid transportation has changed all this. Regions best adapted to wheat production produce wheat, while regions adapted to dairying

produce dairy products, even though the market be a long distance away. Potatoes, for instance, are produced in large quantities in only a comparatively small area. In recent years there has been a remarkable development of areas specializing in the production of fruits and vegetables. Many of these, such as the Rio Grande region of Texas, ship their products to all parts of the United States, and conditions of production are so favorable and transportation so cheap that they find it profitable to do so.

The city man of today starts his breakfast with an orange from California, a grapefruit from Florida, a banana from Central America, or an apple from Virginia, New York, or Oregon. He takes a shredded wheat biscuit made in Niagara Falls from Dakota wheat. He sugars it with the extract from the Cuban cane or the Colorado beet. He puts Wisconsin butter or Vermont maple syrup on his corn bread, made of Illinois corn. He may have a potato. In June it comes from Virginia, in July, from New Jersey, in November, from New York, Maine, Michigan, or Idaho. If he indulges in meat, it may be a lamb chop from an animal born in the Rocky Mountains and fattened in an Illinois feed lot before going to Chicago to be inspected, slaughtered, and refrigerated. He warms himself with a cup of coffee from Brazil, tea from Japan or India, or with cocoa from the coast of Guinea. Transportation facilities make this breakfast possible.

The farmer buys as well as sells. In contrast to the early farmer, the farmer of today buys most of the supplies and equipment which are used on the farm and in the home. Formerly there was very little equipment used on the farm, and feeds and fertilizers were not purchased. Only recently the motive power of the farm was furnished by oxen, horses, or mules which were raised on the farm. Now the farmer buys an automobile, a truck, and a tractor. Not only this,

but he buys the gasoline and oil with which to operate them, while formerly he raised the feed for his horses. Today the farmer buys most of what he uses and sells most of what he raises. For this reason, attention must be given to the buying and selling end of the farming business if the greatest profits are to be realized.

Time of marketing. It is a fact well known to all farmers that the prices received for farm products vary from year to year, and even from day to day. What causes these variations in price? Supply and demand is the answer. Our consumption of wheat is fairly constant. In years of a large crop the prices are likely to be low, but the easiest way to encourage consumption of any staple is to lower the price. Again, in years of scarcity the consumer has to pay a high price in order to get the wheat he wants. The supply of any product is an important factor in determining the

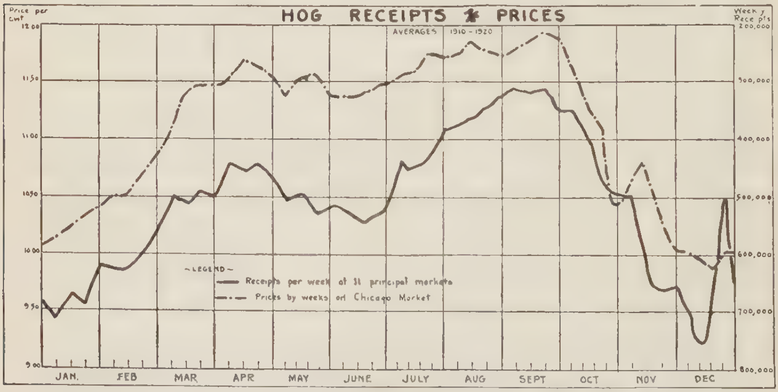

FIG. 109. *Diagram showing average weekly receipts of hogs at eleven principal markets for sixteen years, from 1910 to 1926. Average weekly prices of hogs on the Chicago market for the same period. The price of hogs is lower as the supply increases*

price. The time of marketing also influences the price received. The best time to market our farm products is usually when the supply on the market is low. The prices

for hogs, cattle, sheep, or other farm products vary during the year. By means of cold storage it is now possible to hold over perishable products from times of abundance to

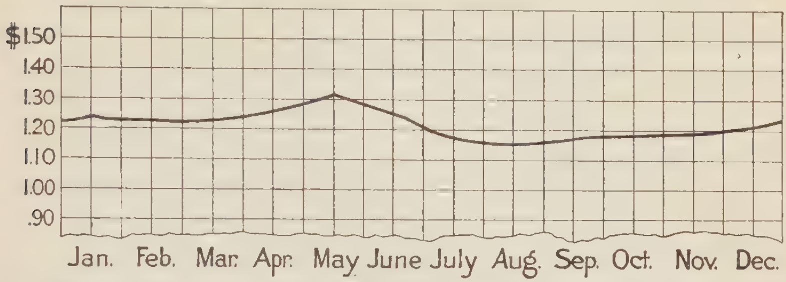

FIG. 110. *Average monthly price of No. 2 red winter wheat on the Chicago market, 1899–1923. The average price of wheat as shown on the above chart is ordinarily highest in May and lowest about the time our crop is harvested. However, the difference between the highest and lowest months was on the average during these twenty-five years only about enough to cover storage, interest, risk, and loss*

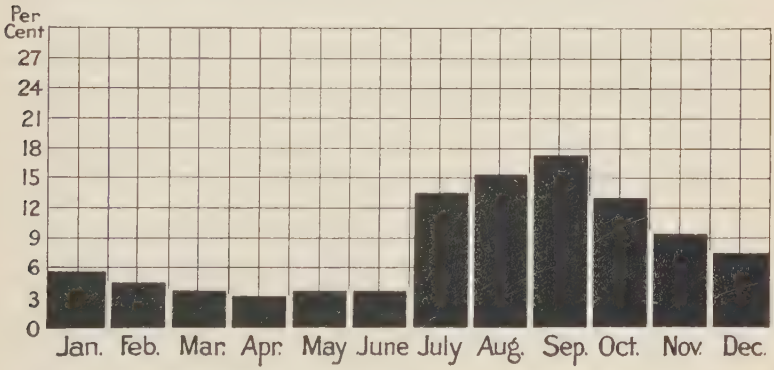

FIG. 111. *Average monthly marketing of wheat, United States average, 1909–1924. Sixty per cent of the United States wheat crop reaches market during the four months at harvest time. The decrease in price at that time compared with the rest of the year is not as great as one might expect because of the ease with which wheat is stored and the definite market for it throughout the year*

times of scarcity, thus helping to level the price during the year. The wise farmer will watch the market and try to sell his products when the price is high.

Place of marketing. Where to market is often a question. The place where the products of farms are to be consumed

is often a long distance from the place where they are produced. California eggs are regularly shipped to New York City. The place where they are needed most is the market where the highest price will be paid. Perishable products such as milk and vegetables were formerly produced near the place of marketing. The development of refrigerator cars and rapid transportation has changed all this, and products are coming to be grown where they can be grown the cheapest.

It is by paying a higher price that one market attracts the products which it needs, or by paying a lower price indicates that such supplies are not needed.

Quality of products. The quality of products makes a difference in the price received. This is easily understood if one goes into a grocery store and observes the different prices of various lots of apples for sale. Some may be purchased at $1.00 per bushel or less, while others are sold at $2.00 per bushel or more. The quality of the apples makes the difference in price. The same is true with other farm products, whether it be milk, hogs, or wheat —the best quality brings the highest price. There is probably no better way of helping to solve the marketing problem than to raise a product of good quality. It will always sell at a higher price.

The middleman. The marketing of farm products has become very complex. The long distance between producer and consumer, the fact that the consumer may not want the product when the farmer wants to sell, or that he does not want it in the quantity which the farmer wants to sell, all are causes which give rise to the middleman. The wheat is sold to the local elevator man who in turn sells it to an elevator in Chicago, from which it is bought by a miller. The miller then sells the flour to a jobber, who sells it to the owner of a retail store, who may then sell the flour

back to the farmer. Or the last sale may take place in a distant city or a foreign land. The gardener may not want to sell his produce in small quantities to customers, and he sells it all to wholesale vegetable dealers who distribute the smaller quantities. Although it is sometimes thought that the charge for this service is high, each man performs some necessary service.

Coöperation in marketing. In the industrial world the tendency has been for manufacturers to combine their plants into large corporations doing a large volume of business. This combination has enabled them to standardize their products and to spend large sums in advertising and other sales expenses. The farming business, however, has not shown any evidence of a tendency for farms to increase in size. Agriculture, a business of small units, has been trying through coöperation to secure many of the benefits in marketing which industry has secured through its large units. By forming an association for improving and standardizing their products, many groups of farmers have been able to find better markets for their products at a higher price.

QUESTIONS

1. Why does the farmer buy so much of that which he uses on the farm?
2. What farm products of your community are sold through a middleman?
3. Where does the live stock shipped from your neighborhood go to market?
4. Where were the plow, the harrow, the corn cultivator, and the automobile used on your farm made?
5. Of the food which you ate today, how much was produced in the state?
6. In what month are the wheat and hogs from your farms usually sold?
7. What service does the middleman perform in marketing?

8. Could we eliminate the middleman?

9. What farm products are sold directly to the consumer?

10. What farm products from your neighborhood are marketed by truck?

PROJECT LESSONS

Exercise I

Object. To find when prices of corn and hogs are highest.

Materials. Two sheets of ruled paper, pencil, and the United States Department of Agriculture *Yearbook*.

Procedure. On the bottom of the sheet of ruled paper write the months of the year. Up the left side, write the scale of prices, from the lowest to the highest. Start with zero on the bottom line and increase the price by fifty cents for each line for hogs and five cents for each line for corn. Chart the monthly price for two years.

Exercise II

Object. To learn the effect of location on the prices of corn and wheat.

Materials. A blank map of the United States.

Procedure. Taking the corn and wheat prices from the *Yearbook*, enter within the state boundary the price of corn and wheat per bushel for each state. Put the corn prices in red and the wheat prices in black.

REFERENCE

Yearbook (latest). United States Department of Agriculture.

CHAPTER XVII

IMPLEMENTS AND MOTIVE POWER

Saving horses and men. Necessity has been the mother of invention in the process of improving implements for the use of man. It is quite probable that primitive man did most of his work in cultivating the soil with a pointed stick. Harvesting was a matter of gathering the crops by hand. The increased population of the world made it necessary for man to devise some method of growing and harvesting larger crops. Implements of various sorts were invented by very early civilizations. Some of these were used unchanged until after the United States had begun to assume a national character. Rapid advancement was not made until about 1850. The improvement of the steam engine marked a period of unusual achievement in types of machinery. As stated in a previous chapter, one man with modern farm implements does as much in one hour as the average man did in an eight-hour day seventy-five years ago.

Plows. The basic operation of farming is plowing. A crooked snag of a tree with an iron point or share was perhaps the kind of plow for which prehistoric warriors beat their swords into plowshares. The moldboard and steel share are of comparatively modern origin. A steel landside was the next improvement. Not many years ago the good old-fashioned walking plow with a wooden beam and handles was the style. Those drawn by one or two horses were considered ample. Riding or sulky plows have been introduced, but some of our older farmers are inclined to refer to them as lazy men's plows. However, where the fields are large and a heavy plow is needed, they are used almost without exception. Gang plows, carrying two or three

plows upon one frame, are usually pulled by a tractor. Large disk plows are made for turning very dry soils. They are used when the soil is too hard and dry for other plows.

Adjustments. Plows require some adjustment in order to get the best results. The improper curve of a moldboard causes a plow to drag, or have a heavy draft. The point of the share must not only be sharp, but it should be slightly curved downward to provide "suction," holding the plow

FIG. 112. *Plowing with a gang and tractor*

in the ground. If the share has the proper length of point and fits properly to the "landside," the plow is easily guided. A "coulter" or cutter is often attached to the beam for cutting tough sod. A jointer is sometimes used for turning under rubbish.

Harrows. For leveling, packing, and cultivating the plowed land, harrows are used. The A-harrow was the original type, made of iron spikes driven through pieces of timber joined in the form of an "A." The section, or spike-tooth, harrow is an improvement over the A-harrow, in that the teeth are arranged in a frame and controlled by levers. Several sections are used at one time. The spring-

tooth harrow is made of heavy steel springs sharpened at the points and attached to a frame. The disk and rotary hoe are used in place of harrows. The latter is especially useful in cultivating soy beans and beets.

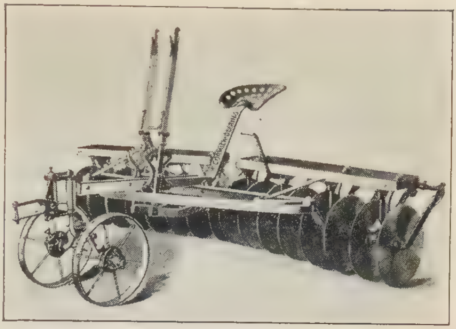

FIG. 113. *The disk harrow has replaced many of the lighter implements of the farm*

Cultivators. The time-honored single-shovel and double-shovel plows were the original horse-drawn implements for cultivating crops. Their virtues were that they were light, easily pulled, and great skill was not required in adjusting them. The two-horse walking cultivator was a great improvement for the cultivation of corn. Both sides of the row could be cultivated at once. Riding and two-row cultivators have been perfected as a result of the shortage of labor and the vast acreage of the Corn Belt. These

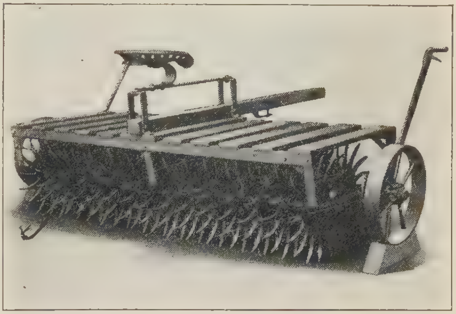

FIG. 114. *The rotary hoe is rapidly becoming a popular implement in cultivating soy beans*

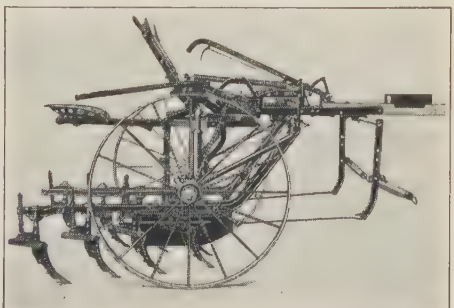

FIG. 115. *A modern corn cultivator has several narrow shovels instead of two or three wide ones*

have been strengthened and improved until they are used extensively with tractors. Two-row cultivators enable the farmer to do twice as much work as he did with the one-row walking cultivators. Crop yields indicate that the quantities have not decreased from the good old days of the double-shovel plow.

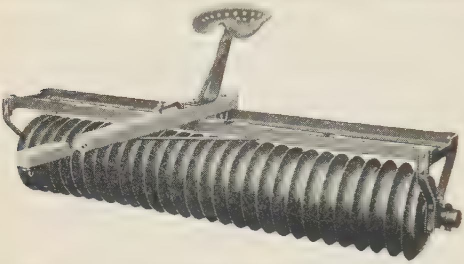

FIG. 116. *A cultipacker is useful in conditioning dry soil as well as in crushing clods*

Tractors. Internal combustion engines were first designed upon the general plan of a steam engine. Instead of steam, gas or the vapor from a highly volatile fluid, as gasoline, was drawn into the cylinder and exploded by means of an electric spark. The repeated explosions drive the piston, providing power. Attempts were made to mount gasoline engines upon wheels, somewhat as traction steam engines are mounted. The first ones were clumsy and did not provide much traction power. The automobile industry has developed the clutch and differential to such a degree of perfection that tractors made upon the same principle are proving a success. There are tractors for almost any size of farm. However, unless there is sufficient work that can be done by a tractor to enable the farmer to dispose of some of his present number of horses, it is doubtful if the tractor will prove profitable. The labor saved and the speed of completing the farm work must compete with the wide application of horse power. Horses reproduce, so that they increase in value while a tractor depreciates. Before buying a tractor and equipping a farm with mechanical power exclusively, it is best to study carefully the methods of farmers who have used tractors for ten or fifteen years.

The care of a tractor. Experimental tractor work has taught farmers many things about caring for a tractor which may prevent wear and the necessity for an early expense

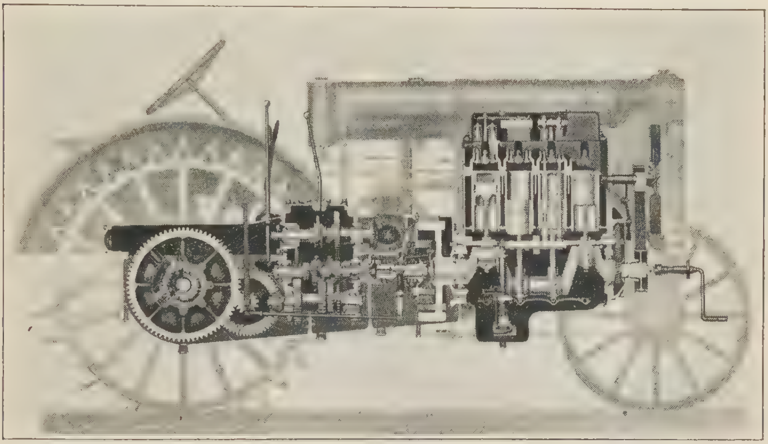

FIG. 117. *An interior view of the tractor showing its construction. Note the similarity to that of the automobile*

in the operation of the machine. The Ford Motor Company suggests a number of points which every tractor owner may observe to advantage, regardless of the kind of tractor he may be using. These points have been summarized as follows:

1. The importance of correct lubrication cannot be too strongly impressed on tractor drivers. The proper grades of oil must be used in the motor and transmission. The oil should be maintained at the proper level at all times and changed frequently.

2. The worst abuse that can be given a tractor is by racing the motor. Drivers must avoid this at all times. When starting, do not speed up the motor to heat up the vaporizer quickly. This is destructive to the tractor and will not accomplish your purpose.

3. Always hitch to the drawbar. Do not hitch a chain or rope around the rear axle housing under any circumstances. Do not attempt to pull tree stumps or do any similar work that might bring the tractor to a sudden stop.

4. Do not attempt to engage or to disengage gears until clutch pedal has been pushed down all the way, nor while the tractor is in motion. Always reduce speed of motor when shifting gears.

5. Do not run the tractor downhill with the gears in neutral or with the clutch released. Engage the gears either in low or in intermediate speed and use the throttle to govern the speed of the motor.

6. If the motor develops a knock, it is important that the cause be investigated at once and corrected. If not corrected, it becomes more pronounced, thereby causing lack of power, and tends to shorten the life of the motor. Do not continue to operate the tractor when the motor fires only in two or three cylinders.

Trucks. The marketing of farm products has become a problem for motor transportation. Railroad freight schedules have been found unsatisfactory for perishable products hauled for a short distance. Improved roads have made possible a more direct delivery, directly from the farm to the consumer. Livestock may be hauled for many miles by means of a truck, while the horse and wagon could scarcely be used for more than five or six miles. Increased demands for trucks have been accompanied by great mechanical improvements and better roads. Aside from caring for the tires, the rules for tractors apply to trucks.

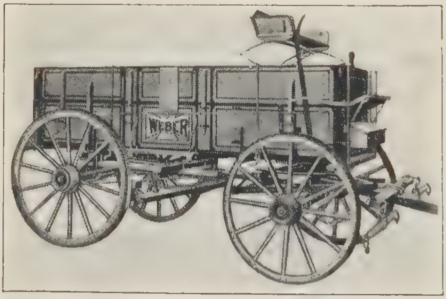

FIG. 118. *The wagon is still the important vehicle upon the farm. A good one is very desirable*

Wagons. With all of the improved power units, farmers still have need of wagons. The time may come when motor trucks will solve all problems of hauling, but wagons are still the rolling stock of the farm. Owing to the vast numbers of uses and the great strain placed upon all parts, a wagon must be constructed of the best material. The wheels are

the most important part of the vehicle. Their height should be determined by the kinds of roads and the uses to which the wagon is put. For farm purposes wagons having low wheels with tires three or four inches wide are the most common. Axles must be strong, made of the best oak. The skeins are the cast-iron or steel ends placed upon the axles for holding the wheels. Bolsters are attached to the axles to carry the rack or bed. Brakes are needed upon wagons for hilly countries. It not only improves the appearance of the wagon, but it also adds to the life, to keep the wooden parts painted. A good grade of axle grease applied to the wearing surfaces of the wagon adds to its lasting qualities and to the lightness of the draft.

Mowers. Haymaking and weed cutting make it necessary for every farmer to have some kind of mower. The larger two-horse mowers are most common. Attachments for tractors are perhaps more satisfactory. The machine may be turned more readily than any other device, and it is quickly uncoupled so that the tractor may be used for

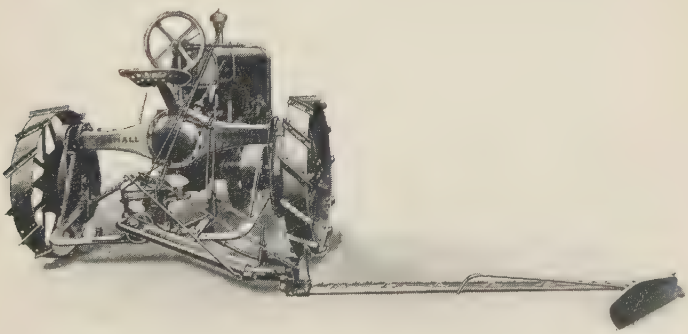

FIG. 119. *The mowing attachment to a tractor solves a hot-weather problem upon the farm*

other work. It is important that the sickle or knife be kept sharp. Rakes and hay loaders are used for gathering hay and loading it.

QUESTIONS

1. Why have farm implements been improved?
2. Why do we need plows?
3. What is the advantage of a disk plow?
4. What is the purpose of a rotary hoe?
5. What advantage is there in using a two-row cultivator instead of a one-row?
6. Is it possible to operate a farm entirely by tractor power?
7. What troubles may arise in the operation of a tractor with the following parts: carburetor, radiator, clutch, spark plugs, cylinders?
8. Is it cheaper to haul products to market with a truck or with a wagon?
9. What parts of a wagon wear most rapidly?

PROJECT LESSON

Exercise I

Object. To learn how a tractor works.

Materials. Notebook and pencil.

Procedure. Visit a dealer who sells tractors and ask him to show how a tractor works. Find out how he starts it. Does it burn oil or gasoline? How is it oiled? For what is the water used? Find what is meant by the differential and transmission. Can a twenty horse power tractor pull as much as twenty horses? Why not? Write a report of your observations, answering the above questions.

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Fordson Tractor Manual. Ford Motor Company.

CHAPTER XVIII

WEATHER

It ain't no use to grumble and complain,
It's jus' as cheap and easy to rejoice;
When God sorts out the weather and sends rain,
Why, rain's my choice.

The weather is undoubtedly the most discussed subject in the course of human life. After meeting a friend and telling him how glad you are to see him, your next remark is about the beautiful weather or the horrible wind. The oldest inhabitant can always recall the days when we had real winters and hotter summers. Things are not as they used to be.

A freeze in Michigan and Wisconsin has caused the price of potatoes to rise. A hailstorm in the Dakotas may raise the price of wheat two cents per bushel in Chicago. Dry weather in the West has often flooded the cattle markets in Kansas City and Omaha. In short, the success or failure, the profits or losses, of farmers are directly connected with the *weather*.

Meteorology, the study of the weather. While it is no longer customary to plant potatoes by the moon, there are some very important facts regarding the weather which have been studied from a scientific viewpoint. Large agricultural colleges have established courses in the study of the weather, or of meteorology as that study is called. Their object is not to forecast the weather for coming weeks, as is done in patent-medicine almanacs, but to learn the effects of changes of temperature and moisture upon farming activities.

Signs and the moon. The Romans believed that the moon and certain stars directly influenced the growth of crops and the destinies of people. There was a sign for everything. Grains should be planted when the sign is in the head, but root crops should be planted when the sign is in the feet. There are twelve signs which represent various planets and the moon, as well as various parts of the human body. They are known as the signs of the zodiac. The farmers of our grandfather's time took much pride in knowing a sure sign for everything. If the sign failed, it was the first time, or a man's grandfather had told him wrong. Experiments have shown that crops will thrive just as well if they are planted when the sign is not right, if proper methods of cultivation and fertilization are followed.

Forecasting. Experience shows that accurate predictions of the weather may be made for from thirty-six to forty-eight hours in advance by following the reports of neighboring regions and by readings of barometric pressure. The latter are made by means of the barometer. The readings are expressed in terms of the amount of pressure required to maintain a column of mercury at a certain height. At sea level the column is about thirty inches high under ordinary conditions. The pressure decreases with the height above sea level, but it is also influenced by weather changes. The influences of the weather upon the barometer are expressed as "high" and "low." Fair weather is usually accompanied by a "high" barometric pressure. Cloudy and threatening weather is accompanied by "low" pressure. Periods of two or three days of "high" are followed by a "low-pressure" area. These usually travel from the west coast of the United States to the east coast. Under ordinary conditions we have two or three days of clear weather followed by two or three days of cloudy weather.

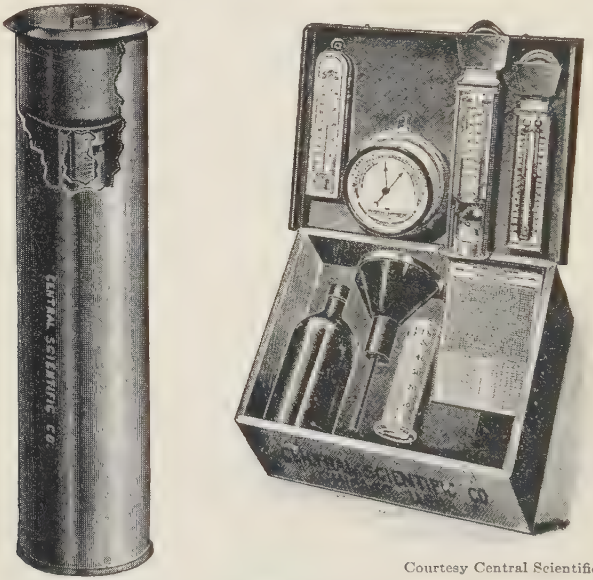
Forecasts are made on the basis of the rate of speed at which these "high" and "low" areas travel over the country. Often a section may not be in the path of a "low" for several weeks, giving a period of clear, dry weather. The opposite is often true, in which case a "high" does not reach a district, and rains are the result. Weather observers issue maps of the United States in which areas of equal barometric pressure are shown by lines drawn to indicate those parts. These lines are known as "isobars." Dotted lines, called "isotherms," indicate areas of equal temperature.

Equinox. During the third week of March and of September there is usually a period of rain or storms, which may be attributed to the influence of the rotation of the earth. Perhaps the sun has some influence upon the weather in this case. Modern weather observers have noted that such a period of storm is no more intense then than a similar storm period at another time. In the course of twenty years it probably has not rained oftener on the twenty-second day of September than it has on October first.

Recording the weather. The Weather Bureau of the United States Department of Agriculture is a very important organization. Stations from which daily reports are sent out are maintained in every part of the country. Observatories are also maintained for forecasting the weather. By careful observation of the barometric conditions, along with the telegraphic reports of surrounding districts, a fairly accurate forecast of weather conditions for the next day may be made. Sudden changes of temperature from hot to cold, storms, cyclones, blizzards, and floods have been foretold. It has been estimated that the forecasts of frost in the California orange groves have saved the growers as much as $20,000,000 in one year by warning them to build smudge fires to protect the trees from frost. Millions of dollars worth of vegetables have been saved by

warnings of coming freezes and blizzards to shippers. Daily weather forecasts, as well as weekly weather charts, may be obtained by those interested.

Precipitation. The rain, hail, sleet, mist, and snow deposited upon the face of the earth are called "precipitation." The hail, sleet, and snow are melted, and the



Courtesy Central Scientific Company

FIG. 120. *Rain gauge and weather-recording outfit*

number of inches of water may be measured as precipitation. The amount of water deposited in this manner may vary from one-hundredth of an inch to several inches during a day. The Weather Bureau does not regard dew, fog, and frost as precipitation.

Rain. The most interesting weather condition is rainfall. Too much rain, or too little rain, is always a matter of speculation. It might be well to recall that rain is vapor condensed at temperatures above the freezing point. So

long as the particles are small enough to float in the atmosphere, they form clouds, but as soon as they become too heavy to float they fall to the earth as rain. The quantity of rain determines the luxuriance of plant growth.

Snow, hail, and sleet. Snow is vapor condensed at temperatures below the freezing point and consists of crystals of various forms. Hail is vapor condensed at temperatures alternating back and forth between freezing and thawing. Hailstones are thought to be formed at high altitudes and to result from the meeting of violent warm and cold air currents. Hailstorms usually accompany thunderstorms and are of short duration. Sleet is frozen rain or frozen snowflakes which had partly melted.

Measurement of rainfall. The amount of water is measured in inches as it would remain if there were no loss by evaporation. Rain gauges are used to determine the number of inches of rain falling. An inch of rainfall means that about one hundred tons of water have fallen upon an acre, or more than sixty thousand tons upon a square mile. Ordinary crops of corn and wheat require about thirty inches of rainfall during the growing season to produce a heavy yield. One hundred large freight cars would be required to carry the water normally falling upon one acre during the year. A rain gauge is used to determine the amount.

Temperature. The warmness or coldness of the atmosphere is called temperature. It is measured by an instrument known as a thermometer. The most common thermometer has a scale marked along the side of a glass tube containing mercury. The rise of temperature causes the mercury to expand up the tube. Cooling causes it to contract. The Fahrenheit scale is the most common method of measuring temperature. Freezing temperature is indicated by the mercury standing at 32°. Boiling temperature

is indicated by the mercury standing at 212°. Atmospheric temperatures may vary from forty to fifty degrees below zero to one hundred and ten or twenty above. Plant life thrives best between 70° and 90° Fahrenheit, although freezing and temperatures as high as 130° do not kill some plants. Daily records of the changes in temperature are kept for every part of the country by the Weather Bureau.

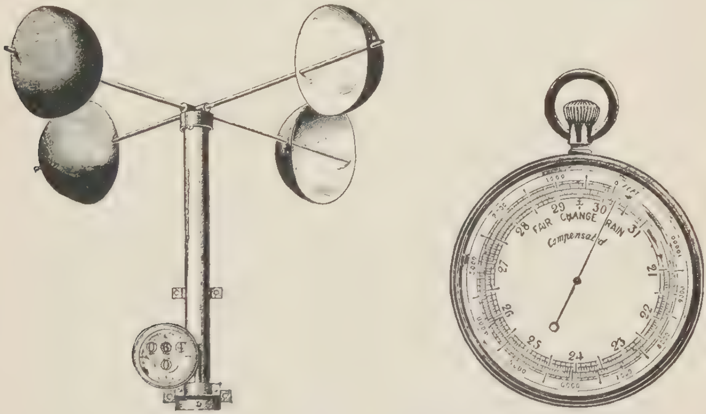
Changes in temperature. The amount of moisture, the velocity of the wind, and sunshine are variable and cause changes of temperature. In summer the days are long and the rays of the sun are direct.

Evaporation is rapid. The presence of moisture in the air produces clouds and an unequal heating of the atmosphere. Winds result as the warm air moves upward and is replaced by cold. Wide areas experience changes in temperature. The weather is colder in winter because the rays of the sun are indirect.

Influence of weather upon crops. Sunshine and cloudiness have much to do with the kinds of crops grown. Spring wheat grows best on the flat plains of the West, where there are long hours of sunlight during the ripening season. Tobacco grows best in cloudy regions or upon the north slope of a hill. In order to secure reduced sunlight, the growers of fine tobacco in Connecticut have shaded whole fields with thin muslin. Corn yields best where there is ample sunshine and moisture, without too much heat and wind.

Wind. Our very early records of the human race contain some interesting stories about the causes of the winds. A common idea concerning the wind was that it was a very vicious force controlled by the gods of the winds, to be released from a hidden cave when humans needed punishment. The mild winds were from the more gentle gods, when they seemed to smile upon the earth.

Wind is the movement of the air. It is caused by the unequal heating of the atmosphere, so that cold air moves toward the warmer air. The rate of movement depends upon the suddenness of the change of temperature. The velocity of the wind varies from one mile to one hundred and fifty miles per hour. A cyclone may be caused by the overheating of the atmosphere or by the deflection of air currents. These currents begin a spiral movement and



Courtesy Central Scientific Company

FIG. 121. *The instrument on the left measures the rate the wind is blowing, in miles per hour. The instrument on the right is a barometer*

develop a terrific force as their speed increases. Great loss of life and of property has resulted from the action of the wind in cyclonic disturbances.

Frost and dew. The rapid cooling of the objects upon the surface of the earth after a warm day produces dew and frost. The moisture contained in the air collects upon the ground. Stones and pieces of metal cool more readily than other things, and the moisture collects there before it does on wood or earth. Frost is frozen dew that has collected upon a cold surface. Wind prevents the collection of moisture, and there is no dew or frost on windy nights.

Clouds act as a blanket, preventing rapid radiation, holding a more uniform temperature, and preventing the formation of dew.

Valleys and river bottoms have heavier frosts owing to the "settling" of cold air and to the shelter from the wind. Frosts kill green plants by freezing the sap inside the leaves, thus tearing down the tissues. Tender plants that have grown rapidly are more easily killed by frost, as a result of the large quantity of water that is contained in the leaves.

QUESTIONS

1. Why is the Weather Bureau an important division of the Department of Agriculture?
2. Mention ten different signs of rain.
3. How is the amount of rainfall measured?
4. What does "precipitation" include?
5. What influence does the weather have upon the kinds of crops grown?
6. What are the extremes of temperature for your community?
7. Why does a tobacco crop need shade while corn needs the sun?
8. Recall some benefits derived from the wind, as well as some damage done.
9. What is barometric pressure?
10. Is there any reason for believing that the moon and planets have an influence upon farming?

PROJECT LESSONS

Exercise I

Object. To measure the amount of rainfall.

Materials. Cylindrical can, and insert or funnel, ruler, as shown in Figure 120, page 218.

Procedure. Place the rain gauge in a place where it will not be disturbed, preferably upon the top of a building where it may catch all the rain. Measurements should be taken each morning and a record made for the month.

Exercise II

Object. To forecast the weather.

Materials. Thermometer, barometer, and notebook.

Procedure. Note the temperature in the morning, at noon, and at night; also the reading on the barometer. Sudden changes would suggest a change in weather. Make a forecast each day at noon for the following day. Record the forecasted and actual weather for the month. Note the times in which the forecast did not correspond to the existing conditions.

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Yearbook (latest). United States Department of Agriculture.

CHAPTER XIX

ANIMALS THAT HELP THE FARMER

BIRDS

Those farmers who grew crops before the year 1890 did not face the problem of crop pests which the farmers of today are fighting.

It is seldom realized what an effective insect-fighting machine is furnished by our common birds. They have adapted themselves to feeding in water, air, earth, and on plants.

The ducks and marsh birds feed on mosquito larvae and the larvae of the blood-sucking flies. Martins, swifts, swallows, flycatchers, whippoorwills, and nighthawks get nearly all their food from the insects which fly in the air. Woodpeckers, nuthatches, chickadees, and warblers seek their daily lunch on forest and orchard trees and other plants. Quail, grouse, partridges, meadow larks, thrushes, and mourning doves search for the insects hiding under leaves and those insects which feed on low-growing plants.

If a bird is feeding on insects we cannot state with certainty that it is a benefit to agriculture, for, as you have observed in the study of insects, some insects are extremely valuable in controlling harmful insects.

We have other groups of birds, such as hawks and owls, that feed on the mice and rats which are so destructive in granaries, in stored fruits and vegetables, and in the girdling of trees.

Summer and winter homes. In order to get a complete picture of the bird population and how the birds ceaselessly work for the farmer, we may classify their residence. Birds may be compared to people, inasmuch as they often move

from place to place to adjust their needs to the climate. With certain birds it is very necessary that they live in a warm climate. We never see insects fly in the air during the cold winter; therefore those birds which depend upon getting their food in the air must migrate to the warm South. Frequently martins and swallows, hasty in their northward flight, are found starved to death after a week of continued cold spring weather.

This extensive adjustment to climate thus places the birds of any locality in four residence classifications: (1) migrants, those which migrate from the South to nest in the region to the north of our locality; (2) summer residents, those spending the winter in the South and coming northward to nest in our locality; (3) winter residents, the birds which nest north of our locality and spend the winter in our more hospitable climate; (4) permanent residents, those birds living in our immediate locality the entire year.

The birds' lunch counter. This classification of residence gives a hint that our farms are large lunch counters which keep the birds supplied with many varieties of food during the year.

The permanent residents feed upon seeds, winter berries, fruits, hiding insects, and insect eggs during the winter months. They vary their diet as spring, summer, and fall pass.

The migrants pass through our locality in the spring and autumn months. Many of them feed on the insects found on trees and near the ground. The largest group of migrants, but the least known, is the warblers, of which there are twenty-five or more species migrating northward in the eastern part of the United States. With their slender, sharp beaks, microscopic insects are eaten from the buds, leaves, and twigs of trees.

The summer residents are distinctly nesting birds. They not only feed themselves, but a group of nestlings also.

Some species frequently eat several times their own weight of food each day. A young robin can consume two to three feet of outstretched worms in a day. A grown man, to eat a corresponding quantity of food in a day, would have to consume about seventy feet of sausage.

FIG. 122. *A robin on her nest with her young*

In the autumn months the migrants are again searching our fields. The summer residents are preparing to migrate to their winter home in the South. Some feed on insects. Others are turning their attention to eating weed seeds.

Those birds which spend the winter in the northern United States consume millions of pounds of weed seed. Some include wild fruits found in the winter. The chickadees and titmice search for hiding insects and insect eggs. Thus, with the ever changing bird population throughout the year, the majority of birds are constantly contributing their bit to our welfare.

How birds get their food. As the farmer requires different tools to gather corn from those used in gathering wheat, so the birds have adapted themselves to getting various kinds of food. The woodpeckers chisel their food from trees infested with destructive wood-boring larvae. Downy woodpeckers often strip the bark entirely from peach trees, to feed upon the bark beetles which eventually kill peach trees. A woodpecker was observed pecking at an

apple tree. He tapped against the bark several times at one place, then moved up several inches and tapped again. This procedure was repeated a number of times in a vertical line on one side of the tree. After the position of the apple-tree borer was accurately determined, a hole was chiseled to the tunnel of the destructive borer. With unerring precision the extraction was made through a hole little larger than the borer itself. One can reasonably wonder how the borer larva was extracted through such a small hole. It was with the aid of a long barbed tongue with a sharp hornlike tip, which works like the harpoons used in spearing whales. The stiff, bristle-like tail and four strong, well-sharpened claws also aid in the capture.

Many of the seed-eating birds have short, strong bills, admirably constructed for crushing seeds. The sparrows, of which there are about forty species, finches, juncos, crossbills, and the quail are some of the common seed-consuming birds.

Flycatchers, which get their food by catching flying insects, may often be heard as they snap their bills over some choice insect. Other birds feeding on flying insects have a small weak bill and a very large mouth which they hold open as they fly. Quick vision and the presence of myriads of insects make such food catching possible. These birds usually have very weak feet, those of the swifts being so small that they are rarely used for standing.

Woodcocks, snipes, killdeers, and plovers have long, soft, flexible bills which are used to extract mud-burrowing insects and other food from their place of hiding.

Wild ducks and geese have strainer-like bills which separate mosquito larvae, other insects, and seeds from the water and mud.

Hawks and owls catch their food alive. They are therefore fitted with muscular feet and long recurved nails to

grip their victims. As they do not swallow their food whole, they have a powerful hooked bill to tear flesh.

Birds as enemies of destructive insects. With these various means and abilities to capture insects, a given insect may have a number of bird enemies. Let us discuss the codling moth, which lays the eggs that hatch the worms which cause wormy apples. The flycatcher and swallows catch some of the adult moths that happen to fly in the daytime. Several warblers or vireos searching for food in the apples tree may find codling moth eggs which have been laid near the apples. After the egg is hatched and the worm crawls into an apple, it is comparatively safe, but it must leave the apple to crawl away to pupate and change into a moth. If the apple is still hanging in the tree, the little pink codling moth larva must make a long dangerous journey to some hiding place under the bark. Many birds that seek their food in trees may waylay him on this journey. Some of the codling moth larvae hide or pupate under the shaggy bark of the apple tree. During the winter woodpeckers repeatedly scour the crevices for these sheltered codling worms. Nuthatches, brown creepers, chickadees, and titmice make further search for those which have been overlooked. If the apple is on the ground, the worm crawls out at the proper time and changes to a pupa under leaves or other rubbish. Each female codling moth will have descendants by the end of the summer. Chewinks, sparrows, robins, blackbirds, quail — in all, thirty-six species of birds are known to feed on the codling moth.

How we find out what birds eat. We are now prepared to discuss the food consumed by some of our common birds. In order to determine the kind of food consumed, the Biological Survey has collected about one hundred thousand birds from all parts of the United States. The stomach or gizzard of each specimen is carefully examined by experts

who are able to identify seeds and parts of insects. Those who identify the insects are able to tell what an insect is by any part of its exterior anatomy. Much valuable information has been collected by the Biological Survey in the past forty years in regard to the importance of birds to farming.

Courtesy Frank Morley Woodruff

FIG. 123. *Flicker preening feathers and in flight*

Insects devoured by birds. Hairy caterpillars, which feed so destructively on leaves, are eaten by cuckoos, rose-breasted grosbeaks, sparrows, jays, crows, orioles, vireos, titmice, tanagers, warblers, and thrushes. Four young rose-breasted grosbeaks were observed to eat 1,000 caterpillars in one day; a scarlet tanager, 630 gypsy moth larvae in 18 minutes; a cedar waxwing, 100 cankerworms. The yellow-billed and black-billed cuckoos are fond of large fuzzy caterpillars that most birds dislike. Their stomachs are lined with the caterpillar fuzz. A cuckoo was observed at a clean-up campaign on a colony of walnut caterpillars, the yellow-striped brownish caterpillars which often defoliate walnut trees. Within three days the caterpillars were all killed. Birds

do not invariably feed on the entire caterpillar, but often take only the internal organs.

One killdeer stomach contained 300 mosquito larvae. Whippoorwills and nighthawks, at each meal, catch hundreds of adult mosquitoes flying in the air. The flicker and the bronzed grackle, when seen on our lawns, are searching for white grubs. One flicker stomach examined contained 28 white grubs. A tree-swallow found flying near a cornfield had eaten 30 chinch bugs. Two house flies were taken from the mouth of a swift which came into the house by the way of the fireplace.

Courtesy Frank Morley Woodruff

FIG. 124. *Mourning dove*

Grasshoppers are eaten by many kinds of birds—small hawks, gulls, thrushes, brown thrashers, shrikes, blackbirds, meadow larks, crows, plovers, and nighthawks. One nighthawk's stomach contained parts of 640 grasshoppers.

Seeds relished by birds. Some of the birds confine their food to seeds. In the stomach of a mourning dove were counted 7,200 yellow wood sorrel seeds and in another 6,400 seeds of foxtail grass. The record count, obtained from a duck killed in Louisiana, was 72,000 seeds of various plants growing near the marsh. Juncos and tree sparrows in the state of Iowa eat 875 tons of noxious weed seed each winter. Seven hundred pigeon-grass seeds were found in one stomach. One quail had eaten 6,000 pigeon-grass seeds. If there were four quail feeding on each square mile in Ohio from December to April, approximately 1,250,000 pounds

of weed seed would be destroyed—enough to sow 62,500 acres of farm land.

Animal refuse consumed by buzzards. The scavenger bird of the United States is the turkey buzzard, which is most numerous in the South. The buzzard's diet consists entirely of decayed flesh, and thus the bird performs a valuable service where animal refuse is common.

Rodents and other animals eaten by birds. Although many of the hawks and owls feed upon the larger insects, they are especially noted for eating small land animals such as mice, rats, rabbits, small gophers, birds, poultry, frogs, toads, squirrels, chipmunks, and crayfish. The farmer and the fruit grower are particularly indebted to those hawks and owls that feed on mice, rats, and gophers.

Field mice frequently become so numerous in sod orchards that great damage is done by their feeding on the bark of the fruit trees. Thus the tree is killed or the owner must resort to the expensive method of bridge-grafting the apple trees. Five sparrowhawks were once observed getting their daily meals from field mice which had become extremely numerous in a large apple orchard. Each day for two weeks one could see these hawks fluttering or suddenly dropping to the ground. Their trust in humanity soon brought them to grief—one day a gunman succeeded in shooting all five hawks. Thus five mousers capable of catching a total of 500 to 1,500 mice per month fell a sacrifice to man's desire to shoot something.

A pair of barn owls are known to have eaten 425 mice in three months. At another owl roost a half-bushel of pocket gopher skulls were found. The food of owls can be determined by the content of the pellets found at the roost. These contain fur and bones of small animals.

The insects, seeds, or rodents eaten by a single bird in a day do not appear to be a significant amount, but when

estimated for a year, for a large army of birds, the quantity of food consumed is measured in tons.

Fruit as food for birds. The extent of good or damage done by a species varies with the individual and with the time of year. Meadow larks, mourning doves, quail, cuckoos, flickers, house wrens, many of the sparrows, warblers, and barn owls do practically no injury to agriculture. Robins, orioles, starlings, catbirds, and redheaded woodpeckers often do great damage to fruit, especially to isolated trees. In large orchards they soon get their fill and leave little evidence of injury. Since the eating of fruit is only temporary, it is just to consider the fruit eaten a charge we are expected to pay for benefits conferred by the birds at other times.

Courtesy Frank Morley Woodruff
FIG. 125. *Meadow lark singing*

The food of birds in pioneer days. Before this country was settled, birds depended upon wild fruits for their fruit diet. The shrubs bearing wild fruit have been removed; therefore resort must be made to the cultivated fruits. It is possible to plant wild shrubs that will furnish the necessary fruit diet at the proper season. However, the fruit of these shrubs must ripen before the fruits to be protected. Russian, New American, and Downing varieties of mulberries are best to protect cherries, strawberries, and raspberries. Red-berried elder and June berry (Amelanchier) are native shrubs which fill the same requirement. Elder, common

wild cherry, and chokecherry are sought by birds in the middle and late summer period. Other plants which furnish fruit food for birds are sumac, wild raspberry, wild blackberry, blueberry, Virginia creeper, wild grape, pokeweed, viburnum, bittersweet, and dogwood.

Providing food for birds. Wild birds can be encouraged to come near the house if well-provisioned food shelters are placed near a window. Woodpeckers, chickadees, nuthatches, and juncos can easily be attracted.

A food shelter must be so constructed that the birds can readily find the food and that the food will not be blown away by the wind or covered with snow.

A winter lunch counter for birds may be stocked with several of the following: cracked corn, crumbs, hemp seed, millet, nut meats, peanuts, rolled oats, raw or boiled rice, sunflower seeds, wheat, crackers, buckwheat, birdseed, slices of apples, shreds of meat, cooked meat, fat, or suet.

Quail frequently starve to death in the winter when all vegetation is covered with ice. Flocks known to be in certain localities can be protected from starvation if food is placed under a brush shelter near their haunts. Cracked chicken feed, wheat, millet, or buckwheat serves the purpose.

Our attitude toward birds. Many problems influence the attitude which should be taken toward some of our birds. Does the good overbalance the evil?

The purple martin is often accused of eating bees. However, examination by biologists has disclosed that a large proportion of the bees eaten are drones. To offset the damage which it may do, the martin consumes numbers of clover and nut weevils.

The kingbird is also accused of eating bees. These have also been found to be chiefly drones. Robber flies, which destroy bees, rose chafers, and many other harmful insects, make up 85 per cent of the kingbird's food.

The blue jay is rightly considered a culprit. Although it feeds on a few harmful insects, waste grain, and acorns, it also feeds on the eggs and young of many of our beneficial birds.

The bronzed grackle, often known as crow blackbird, also robs smaller beneficial birds of their eggs and young. These birds congregate in the fall and destroy much grain. They eat large numbers of weevils, cutworms, and army worms. The grackles seen searching the lawns find many white grubs and also many adult forms, commonly called May beetles.

The crow also joins in robbing birds' nests of their eggs and young. Much damage is often done to sprouting corn. Although destructive insects such as wireworms, cutworms, and white grubs are eaten in great quantities, nevertheless from an economic standpoint it is best to reduce their numbers where numerous. The most efficient means is to lure them into a crow trap.

The English sparrow is ranked as a universal pest. There is probably as much to be said for as against this foreigner. In many places it has become an unsanitary and noisy nuisance. It is true that great quantities of grain are consumed in certain localities and during certain periods of the year. The extent to which other birds have been driven out of the cities by the English sparrow is doubtful, as the sparrow and starling are the only birds that have adapted themselves to the strenuous conditions of bird life in a large city. The English sparrow is known to destroy great quantities of harmful insects which feed on farm crops and ornamental plants. With the decision to destroy this bird should be included a study of the good it is doing in a locality.

The European starling, also a foreign bird, introduced into New York City about 1890, has a record similar to the

English sparrow. The greatest damage done by this bird is to fruit crops. Recent studies of the Biological Survey have revealed that it feeds upon many harmful insects, and the chief possibility of damage is to fruit trees visited by large colonies of starlings.

The sapsucker is a woodpecker which has developed the peculiar trait of punching many holes in the bark of a tree to feed upon the sap. Frequently the tree is injured.

Courtesy Frank Morley Woodruff

FIG. 126. *Sharp-shinned hawk, one of the bird culprits*

The cowbird is distinctly a beneficial bird in regard to the food consumed, but the female has abandoned the art of nest making, and has chosen to let smaller birds do this work. This results either in abandonment by the host bird before the eggs are hatched, or in starvation of the nestling birds. The young cowbird is much larger than its nest mates and requires much more food than the parent birds can supply to the entire nestful. A cowbird, therefore, is often raised at the expense of several of the smaller birds.

The hawks and owls are probably more universally condemned than are any other group of birds. Because certain hawks catch poultry, all medium and large-sized hawks

have been considered "chicken hawks." Many of the large owls have been shot because they were rare curiosities. Shall we leave to future generations nothing but the bare history of many birds that once lived on the North American continent? Fifteen species have become extinct in Ohio within the past seventy-five years.

Courtesy Frank Morley Woodruff

FIG. 127. *Cooper's hawk – nest and adults*

Great numbers of hawks and owls have been killed because the state paid a bounty for each head. Many states have found their fields overrun with mice a few years after a state-wide drive against hawks and owls has been carried on.

Injurious birds. *Hawks.* In order to learn the injurious and beneficial hawks and owls, it is best to describe the injurious ones, as there are only three hawks and one owl that are persistently injurious. Many of the other species will take a chicken when driven by hunger. The difference in this case can be illustrated by the schoolboy who takes an apple when he thinks he is desperately hungry, which is not considered a serious offense; and the one who carries away a whole bushel of apples. The sharp-shinned and cooper's hawks are medium-sized (fifteen inches in length);

the underparts are gray, barred with pale brown. The tail is distinctly barred. The tail of the sharp-shinned hawk is square, that of the cooper's hawk, rounded. The goshawk also belongs to this marauding trio. The size is about eight inches to ten inches longer than that of the previous-named species. The underparts are grayish, finely barred with brown.

Owls. The great horned owl is the only one of the owls that is destructive. It is easily identified, as it is the largest of the owls and has two prominent horns or eartufts and a white patch on its throat. This owl is so bold that it can kill a skunk without a bit of discomfort.

Courtesy Frank Morley Woodruff

FIG. 128. *Another culprit, the great horned owl*

Bird population. How many birds may be found on the average farm during the nesting season? A number of persons in various parts of the United States have volunteered to take a census of birds nesting on a certain area. For a number of consecutive mornings the census taker makes a count of the male birds seen or heard singing. Each male represents a nesting pair of birds. The census of each locality is sent to the Biological Survey at Washington, D. C., and the data are compiled each year.

For the region east of the Rockies and north of the Potomac and Ohio rivers, an average of 800 pairs are found per square mile. The northeast and north-central states have 110 pairs for each 100 acres. There are 182 pairs to

each 100 acres in woodlots, while there are only 130 around farm buildings. The greatest number of birds are found where orchards and shrubbery abound.

The most abundant birds in the northeastern states are robins, song sparrows, English sparrows, and chipping sparrows in the order named. In the north-central states English sparrows, robins, meadow larks, catbirds, and song sparrows rank in number of pairs per 100 acres in the order given. In many localities, especially in parks where birds are protected, as many as 10 nesting pairs are found to the acre.

Effect of weather on birds. Why does not the bird population increase? The Biological Survey has discovered that the population greatly decreased after a year of unfavorable weather. This is particularly the case with insect-feeding birds. The insects remain dormant, and insect eggs do not hatch until the weather becomes favorable. Swallows and martins are especially liable to starvation in cold weather when insects do not fly.

Natural environment. Many other factors tend to reduce the number of birds. The drainage of marshes greatly reduces the population in a given territory. In some of the large marshes where great numbers of shots are fired at ducks, these birds have often been found dying of lead poisoning from the shot picked up in the shallow marsh. Man is often an indirect reducer of bird population through the removal of trees used by owls, woodpeckers, and other tree-nesting birds, through the removal of nesting sites along the fence rows, and through the destruction of nests while he is cultivating fields or harvesting crops.

Enemies. During the observation of a large number of nests in a woodlot and orchard, 60 per cent of the nests were abandoned or destroyed before the young were ready to fly. The causes of abandonment and destruction were the

presence of cowbird eggs, robbery by squirrels, mice, crows, cats, jays, grackles, skunks, and snakes. In some localities mink, weasels, and opossums also damage many nests.

Banding birds. The placing of a narrow metal band on a bird's leg is another practice which has greatly enriched our

Courtesy St. Adelbert School, Cleveland, Ohio

FIG. 129. *A bird-house contest*

information on the life of a bird. It provides information as to direction and speed of the migration and a possibility of determining the age of birds. The banding is done by members of the Biological Survey and many persons studying bird behavior. If a dead bird is found with a band on its leg, the band should be removed and sent to the person who placed it. If that point is uncertain, the band should be sent to the Biological Survey at Washington, D. C., with a statement giving date, place, and kind of bird from which the band was taken. If the bird is alive, the band should

not be removed, but the number, date, place, and kind of bird should be recorded and the data sent to the proper place.

FRIENDLY MAMMALS AND REPTILES

Mammals. In discussing the great army of workers that are keeping agricultural pests in check, it would be unfair to omit two of our important mammals and the reptiles.

The *bat*, although equipped with wings, is not a bird, but distinctly a mammal with a special adaptation. Its chief food is mosquitoes and night-flying insects, especially moths. The bat does not swallow its food whole, but chews it as a horse chews hay. The city of San Antonio, Texas, found the bat so valuable in controlling the mosquito pest that a municipal bat roost was built in which thousands of bats soon took refuge.

The *skunk* has often been found in the poultry house, occasionally destroying birds' nests and bumblebee colonies. However, it feeds on thousands of insects and mice. The rounded holes that are often seen in the fields are made by skunks searching after white grubs and the adult May beetle.

Snakes. Although snakes are repulsive to most of us, it is necessary to consider them beneficial as a group. Many are harmless, and the two common venomous species of the northern United States are so retiring that only the extremely careless are injured. *Black snakes* are often seen crawling into the runways of field mice. Dozens of *rattlesnakes* examined were found to have eaten nothing but the destructive field mice. The *fox snake* or *redheaded coluber* is the only species that is often found feeding on birds.

Vermin drives. It is timely to discuss vermin drives at this point. Many communities have vermin drives during the winter or spring of the year. Mouse, rat, woodchuck,

weasel, and mink tails, and hawk, owl, and crow heads are collected by the opposing sides. Each tail or head counts a certain number of points. The winners of the contest are given a banquet by the losing side. A number of these contests have been investigated with the result that many valuable hawks and owls that kill 500 to 1,500 mice annually were included with the vermin. Any person who has ever caught 500 to 1,000 mice and rats can readily appreciate the work saved by a good hawk or owl. The contestants in a vermin drive should be well posted on the identification of hawks and owls, and heavily penalized in points for any valuable species killed. Every day is a vermin drive for these birds.

QUESTIONS

1. Name and describe the hawks which are not beneficial. The owls.

2. Classify the following birds as to their residence in your locality: quail, robin, blue jay, kingbird, meadow lark, junco, Canadian goose, and black-and-white warbler.

3. Is the bat a bird or a mammal?

4. Do you think a state legislature is justified in passing a law which pays a bounty on all hawks and owls?

5. Name the chief enemies of our beneficial birds.

6. Which birds usually live in colonies?

7. What kinds of birds have you seen gather in flocks to prepare for their southward migration? Is there a possibility that this habit might be destructive to agriculture in certain localities?

8. Relate the status of the cowbird.

9. What are the essential things to do if a live banded bird is found? A dead banded bird?

10. English sparrows are very persistent in using the nest boxes of other birds. How may they be kept from a wren house? From a bluebird or martin box?

PROJECT LESSONS

Exercise I

Keep a migration record of arrival of birds from January to May.

Exercise II

Make a list of the species in the following groups of birds that are found in your locality: (*a*) woodpeckers, (*b*) sparrows, (*c*) swallows, (*d*) thrushes, (*e*) hawks, and (*f*) owls.

Exercise III

Construct a bird shelter or a bird house. (For suggestions see *Farmers' Bulletins 621* and *1456*.)

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CHAPTER XX

PLANT NUTRITION

Energy. Now all the activities of which we have been talking in the preceding chapters require energy. In fact, the activity of any living organism uses up energy. Energy is an indefinable something which enables us to do work. The way we get it is through food. Food, therefore, is a form of potential energy. When we or other animals become hungry we are simply feeling the need of a new supply of energy-containing materials. Let us see how energy comes to be stored in food, or, in other words, how foods are made.

Sources of food. All the foods are from two general sources, the animal kingdom and the plant kingdom. But since the animal kingdom gets its food from the plant kingdom, we can say that directly or indirectly all the energy stored in foods comes from the plant kingdom. This may not at first be apparent. Let us take as an illustration the whale. Let us see if it ultimately gets its energy from the plant. It eats fish or other animals which eat other fish, and so on down until some point is reached at which the animal eats the sea plants or algae. And so here too we may say that the plant is the only original source of food. In fact, we too are dependent on the plant kingdom, as are all other animal beings, from the flea to the elephant. The plants alone are independent food-makers, or energy storers.

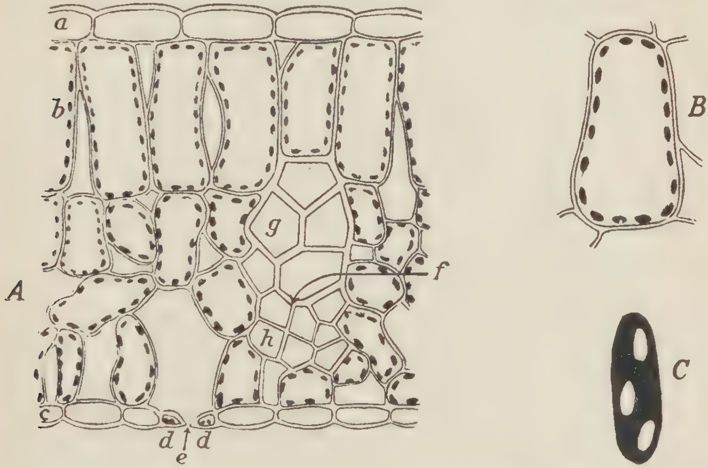
But while we are studying about food manufacture, let us think of food for plants, not of food for ourselves, for that which we use is made by plants. We merely rob them as we do the cow in taking its milk. Besides, much food that the plant makes for its own use is not food for us, though it may have other very important uses for us. For instance,

castor oil is a food of the castor-bean plant, but is not a food for man, though it has a medicinal value and an industrial use. Besides this, the plant stores away great supplies of energy, which cannot be classed as food although some animal may eat them, but which have a tremendous importance for man. Besides our foods, we owe to plants our fuels, lumber, paper, clothing, etc., and all our power except that derived from wind, waterfalls, and tides. Thus, after a little study, we come to realize the rôle played by the lowly plant in the living world, not only today but through ages past, and it takes on an importance we could not have realized.

The green plant. Then let us inquire into the processes by which food is made. You have noticed that most of the plants which you know are green in color. You may have thought this coloration was for its ornamental value only, but that is far from the case. That green pigment, called chlorophyll, is essential to the food-making process, and those plants which do not have it are, like the animals, dependent on the green plants for support. It is the green plant, whether it be a microscopic alga such as the green scum on the pond or a giant tree, with which we are concerned.

The food factory. In the plants with which you are familiar the "food factory" is usually spread out into a flat, thin sheet — the leaf. This is the place where most of the food is made. Why is it thus spread out and why is it usually so thin? You will doubtless answer, "To get more sunlight." But that is only part of the advantage gained by this structure. To understand the entire advantage, let us examine the inside of a leaf. This we may do by cutting a very thin cross section of a leaf with a sharp razor and examining it under the microscope. Such a cross section is pictured in Figure 130. Beginning at the top, you will see first the upper epidermis, a layer of small cells on what is the upper side of the leaf. This layer is not green. It is

colorless, and makes no food, but furnishes protection. Next under it come the long cells called palisade cells, containing little green disks. These are the little chloroplasts which are the food manufacturers. They make the food and store it temporarily in the form of tiny starch grains



Courtesy Henry Holt & Company, New York

FIG. 130. *A highly magnified section of a leaf*

A—The cells which manufacture the food
B—Cell from A
C—Single chlorophyll grain from B
a—Upper epidermis
b—Palisade cells
c—Lower epidermis
d—Guard cells
e—Stoma
f—Vein region
g—Xylem, large, heavy-walled cells
h—Phloem, small, heavy-walled cells

right in the chloroplast itself. Now just below the palisade tissue is the spongy tissue. As you will see, this is made up of more nearly round cells with many irregular passageways between them, giving the tissue a spongy appearance. These cells, too, contain chloroplasts and, of course, can make food. Finally we reach the underside of the leaf, the last layer or lower epidermis, consisting of colorless cells much like the upper epidermis. In many plants this lower epidermis bears a growth of fine plant hairs and, in some, both sides of the leaf produce hairs, called the cuticle.

In the lower epidermis can be seen special openings called stomata (singular, stoma), small apertures between two guard cells which open into the passageways among the spongy cells. These stomata allow the gases which the plant needs to pass in and out to and from the cells which are on the inside and contain the little green chloroplasts. They connect with the passages between the cells and allow considerable ventilation of the leaf. Here, then, we have another advantage of the leaf's thinness, for if it were thick it would be harder to ventilate and get gases to penetrate the interior. This structure, however, allows water to evaporate from the cells quite rapidly, especially during the day when the stomata are open. The loss of water is not usually good for the plant, and may cause serious injury if the roots are not in moist soil. When the water evaporates too fast and the soil is dry, the stomata close, thus preventing the other gases from entering and stopping food manufacture as well. Now you will notice the vein region. This is the part of the conductive system which carries water and foods in the plant. Note that it is made up of two parts, the xylem, which carries water, and the phloem, which carries food. The vein will lead back to the midrib (Fig. 130), and the midrib leads back to the stem which extends to the roots. Thus the leaf is connected by this conductive system with the soil, from which it gets its water and minerals.

The raw materials used by plants. This, then, is the structure of the "food factory" of the plant, and the little green chloroplasts are the workmen. Let us see next with what they work. It has been found that green leaves are constantly taking in from the air carbon dioxide, or CO_2 as the chemist calls it. Now as soon as this gas goes through the stomata and the air passages and strikes the moist cell wall, it dissolves and goes in as a liquid. This

liquid is the raw material which the workmen will use and make into food. It is now what we call carbonic acid. Its formula is very simple: $CO_2+H_2O=H_2CO_3$, or carbon dioxide+water=carbonic acid. This, then, is worked up into food by the chloroplasts. But the workman must have power, *energy*, for he is going to put into this little food molecule a lot of energy which we who eat it, or the furnace that burns it, can get out again. The chloroplasts, therefore, must have a source of energy, and that source is the sun. That blazing ball ninety-two millions of miles away furnishes directly the energy which runs our bodies and our engines. This sunlight is partly absorbed by the green chlorophyll, and as it is absorbed it is changed over from light energy to food or chemical energy, and oxygen (O_2) is set free. Then, by simple subtraction, all we have left in the leaf from the CO_2 which came through the stomata is: $CO_2-O_2=C$, or the carbon. That is why we call this food manufacture of the leaf "carbon assimilation." The O_2 goes out to the air through the stomata of the leaf, just as the CO_2 came in. The carbon and some water are left as the food, and the process is complete. This first food we can represent as $C_6H_{12}O_6$, or glucose, one of the sugars, often called grape sugar, of which corn syrup is a fairly pure illustration. This is changed to starch, which is not soluble, and can thus be packed away better. It is mostly kept until night in the chloroplast, then, during the early part of the night, is transported by the plant either to the growing parts, to be used in building new tissues, or off to the place where storage is going on, such as in the seed, tuber, roots, etc. To be transferred, this starch must be changed back to sugar again. Then when it arrives at the storage point, such as the new grains which are being formed in a wheat head, the sugar is changed back to starch and stored in the grain. We take it when we grind the

wheat into flour, the main bulk of which is starch. At the storage point other foods may be made from this glucose when it arrives. If it is a fatty seed such as flax which is being formed, then the glucose will go through another marvelous change which we do not understand and be made into linseed oil. The plant is a chemical wizard, indeed! If protein is to be stored — and all seeds contain some protein — the glucose is changed to acids in the leaf, and linked up with mineral elements taken up from the soil, chiefly nitrogen, with some phosphorus and sulphur, and these are made into proteins. These foods, the sugars and acids, move through the veins also, but through that part called the phloem, while the water going up to the leaf moves through the xylem, as mentioned above.

The substances derived from the soil are taken up by the roots through the tiny root hairs. Before they can be taken up by the root hairs they must be in solution. In that form they pass into the root hairs, and the process by which they are able to enter is known as osmosis. Thus it will be seen that plants take material from both the air and the soil. Altogether, ten different substances are required. The chemist calls them elements. They are nitrogen, phosphorus, potassium, calcium, magnesium, iron, sulphur, carbon, hydrogen, and oxygen. Other elements are sometimes found in plants, but they are not essential.

Food digestion. We have seen briefly how the food is made. But food as such is of no use to the plant or animal. It must first be digested. Then it must be transported to the place where it is needed. Even then it has not done its work. It must be burned, or respired, before the energy is released. In fact, that is what respiration really is — the slow combustion of a substance with a yield of energy. Let us take a grain of starch and watch the plant use it up. It must be remembered that the plant is a living being. As

we have just seen, it is more independent than we are, since it can produce its own food. And as a living thing the plant respires. It simply uses up part of the food it makes itself. It makes food only in good light (although this can be artificial light), but its respiration goes on always in light or darkness until death ensues. The starch grain to be used

FIG. 131. *The roots of some plants are used for food. Here are shown: beet, parsnip, carrot, and turnip*

is converted by a small body called an enzyme into sugar, and this is moved to the point where it is needed. There the plant compels this sugar molecule to give up its energy. But to do this it must have oxygen. A supply of oxygen, therefore, is necessary for plants as well as for animals. This O_2 goes in through the stomata just as it came out when released in food manufacture, and is again linked up with the carbon from the sugar, coming back out again as CO_2, or carbon dioxide. This is just the reverse of the gas exchange in the food-making process. Thus the energy

stored in the starch and sugar is released again and can be used by the plant.

Work done by plants. It is hard for the student to understand just how plants need and use energy — that is, how they do work; but they actually do considerable work at their extremely slow rates. Most of the work done by plants is in building new tissues and organs — that is, in growing. In some cases this growth is under difficult conditions, and we

Fig. 132. *Leaves used for food: cabbage, lettuce, onion*

can see that much work is being done. For instance, puff balls have been known to lift a cement paving block, and roots commonly split rocks apart. Many plants do work in certain movements which they make, such as the daily movement of the sunflower, the grasping movements of tendrils in climbing plants, or twining movements of plants such as some of the beans. The making of food itself uses up a certain amount to keep the process going. Besides this there are many ways that cannot be explained here in

which the plant does work, needs energy, and thus uses up its own food. It commonly sends out a good supply of food with the little plant contained in each seed, and some plants store much food for the next season in an underground stem or root. These storage organs—seeds, tubers, and roots—are the chief sources of food for man.

FIG. 133. *Stems used for food: rhubarb, potato, and celery*

The edible part of plants. Broadly speaking, there are five different parts of a plant: (1) root, (2) stem, (3) leaves, (4) flower, and (5) seed. Usually that part of the plant is used for food in which products have been stored most abundantly. For example, it is the root that one eats in such plants as the garden beet, carrot, or parsnip; the stem in celery, rhubarb, or potatoes; the leaves in cabbages, onions, or lettuce; the flower in cauliflower; and the products of the flower or seed in cereals, nuts, fruit, etc.

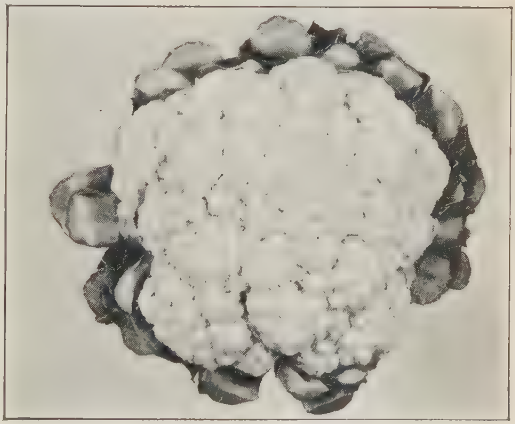


FIG. 134. *Flower used for food: cauliflower*

Let us now summarize: 1. The green plant catches energy from light and makes the carbon dioxide (CO_2) give up its oxygen (O_2); it makes the carbon (C) take up water (H_2O) and become sugar ($C_6H_{12}O_6$), which is food. This sugar is stored as starch, or may be used at once in respiration or growth, or be taken as food by man or other animals.

2. In this process of food manufacture, the plant must take in CO_2 and give off O_2, and thus purify the air. These

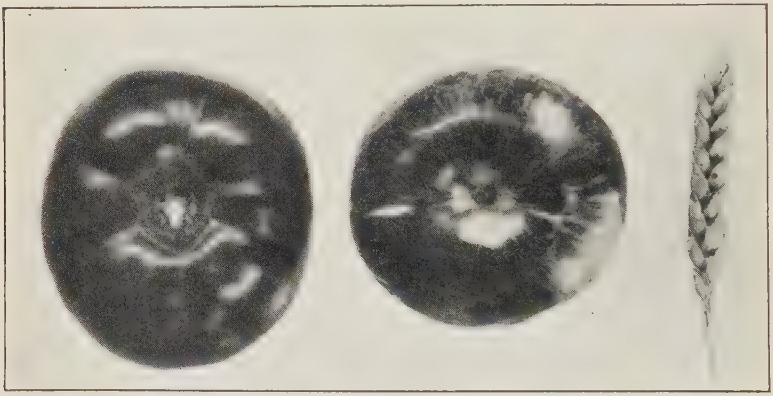


Fig. 135. *Products of flowers used for food: tomato, apple, wheat*

gases pass through the stomata into the air passages inside, or out to the air.

3. Water is necessary for all the cells of the plant. Food manufacture goes on only in the watery interior of the green cells. The water is conducted by the conductive system up the stem, through the midrib, and out the veins, from which it may be drawn by the cells of the leaf as it evaporates off into the air.

4. Respiration is the release of energy by the using up of food. The plant respires always while living. It takes in O_2 and gives off CO_2, just as the animal does. This sends the CO_2 back into the air, from which it may be taken again by the plant for food manufacture.

We have had only a glimpse into one of the greatest processes of nature, if not the greatest, without which no life could exist. The subject of botany should be studied for further details about the plant and its processes.

QUESTIONS

1. Name two sources of food.
2. Discuss the leaf as a "food factory."
3. Name the ten essential elements required by plants.
4. Give a few illustrations showing that plants produce energy.
5. Name five different parts of a plant.
6. What part of the plant do we consume when we eat carrots, potatoes, onions, cauliflower, fruit, sweet corn?

PROJECT LESSONS

Exercise I

Object. To show that moisture escapes from the leaves of plants.

Materials. Wide-mouthed bottle and a potted plant.

Procedure. Carefully invert the bottle over the plant and after a time note the collection of moisture on the sides of the bottle.

Exercise II

Object. To prove that passageways exist in the stems of a plant.

Materials. A few stems of green plants, red ink, water, a sharp knife.

Procedure. Place the stems of some green plants in water colored with red ink. After a few hours, cut the stems. The colored surface shows there are passageways in the stems through which water passes.

Exercise III

Object. To demonstrate the presence of root hairs on the roots of corn.

Materials. Kernels of corn, sand, bottle, and black paper.

Procedure. Germinate a few kernels of corn in sand or sawdust placed in a bottle covered with black paper. After the corn is several inches high, remove the paper and note the roots covered with root hairs.

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CHAPTER XXI

SOILS AND THEIR MANAGEMENT

We have seen that plants are little factories in which is manufactured the world's supply of food for both man and animals. While the plants obtain over 95 per cent of their raw material from the atmosphere, the rest, which comes from the soil, is indispensable. It is therefore important and necessary for us to know something of the nature of soil in order to grow crops successfully. Of what is it composed? From what is it made? How is it formed? If we know something about these things we shall be the better able to handle the soil so that it will yield bountiful crops.

Origin of the soil. From our geographies we have learned that the earth was, at one time, a red-hot molten mass which upon cooling formed a crust of solid rock. In the cooling process it contracted and the surface wrinkled in much the same manner as does a potato when it dries up. Geologists tell us that water gathered in the low places and that continents emerged between. As the cooling process went on, the earth continued to contract and wrinkle and thus great mountain ranges were finally formed.

Water. Many agencies have helped to pulverize the earth's crust to form the soil. Throughout the ages, water has been eroding and carrying rock particles from mountain top to valley. The same process is going on now, as is evidenced by the washing of deep gullies on hillsides and the formation of sand beds along streams during high water.

Aside from the rubbing action of water, it also acts as a solvent, many rocks dissolving in it the same as does salt.

In pure water, however, rocks dissolve very slowly, but water usually contains carbon dioxide, the presence of which causes rocks to dissolve more rapidly.

Heat. If we were to examine closely a few rocks, we should find that each is made up of a mass of many different kinds of particles or matter. Heat causes the minerals to expand, and cold causes them to contract, but not all of the particles expand and contract alike. The difference in the degree of expansion and contraction results in a splitting and breaking off of small particles of the rock.

Air. Into the cracks and crevices of rocks air enters and causes a kind of decomposition or decay, just as it causes rust to form on a pair of skates while they are stored away through the summer.

Plants. In crevices and even on the smooth surfaces of rocks the lower forms of plant life, such as lichens and mosses, may grow and slowly disintegrate the rock. Have you ever noticed a shrub or tree growing on the side of a rocky ledge? The penetration of the roots has great power in cracking and spreading the rocks.

Worms. The cast thrown up by a single earth worm does not seem important, but when the hordes of earth worms even in a single acre are considered, the amount of earth moved by them is truly marvelous. The passing of the material through the digestive tract of the worms further pulverizes the rock particles.

Through these and other agencies the crust of the earth has been pulverized to form the soil. But plants cannot grow on broken particles of rock alone, no matter how fine they may be. To these must be added the refuse which comes from the decay of plants and animals, known as organic matter. When the refuse from plant and animal life is completely decayed, the product is known as "humus." The amount of humus in the soil is important because it

determines largely its water-holding capacity, and it also gives it color. The greater the supply of humus, the darker is the color of the soil.

From what has been said, it is evident that soil is not a mass of inert "dirt" as is thought by many people. It is a mixture of small particles of rock and of plant and animal refuse. It contains air and water, and is teeming with plant and animal life.

Kinds of soil. There are so many different kinds of soil that in order to distinguish one from another it is necessary that the different types have a name the same as each of the various breeds of cattle has a name. There are various ways in which soils are distinguished.

Geological classification. Geologists name soils according to their origin. They usually distinguish four kinds: (1) sedentary or residual, (2) alluvial, (3) glacial or drift, and (4) aeolian or loess.

Sedentary soils are those which remain where they are formed. They are like the rock over which they lie. Alluvial soils are those formed by the action of water. The muddied streams after rains are evidence that soil particles are being carried from hilltops to ponds, lakes, or flood plains, eventually to form new soils. Soils formed in this way are usually unlike the rock over which they lie. Other soils are also unlike the underlying rock, but have been formed by the action of glaciers. These are known as drift soils. They are common in the northern part of the United States. Loess soils consist of fine particles which have been deposited by the wind. These are quite common in the sand regions west of the Mississippi.

Agricultural classification. From an agricultural standpoint, soils are divided into many groups, the names of the more important ones being (*a*) sand, (*b*) clay, (*c*) loam, (*d*) muck, and (*e*) peat. This classification is based largely

on the fineness of the soil particles, the amount of organic matter, and the degree of its decomposition.

In sandy soils the rock particles are relatively coarse, in clays they are extremely fine, and in silts they are intermediate. Soils in which the proportion of clay and sand is about equal, and which contain an appreciable amount of organic matter, are known as loams. Loams may be sandy, silty, or clayey, depending on the kind of material that predominates. Soils composed almost completely of decayed organic matter are known as muck. Before the organic matter is completely decayed it is called peat. When dried, peat burns readily.

Soil and subsoil. All land, regardless of its origin or composition, has a soil and subsoil. The soil is the layer of ground which is plowed up and cultivated. It is usually six to eight inches deep. The ground underneath the tilled soil is known as the subsoil. Ordinarily it is lighter in color than the surface soil, and more difficult to work. Sometimes the term "soil" refers to all that which is dark in color, in which case it may extend to several feet in depth.

DRAINAGE

In the successful and profitable management of soils good drainage is necessary, for experiments have shown that ordinary farm crops will not grow with wet feet. In some parts of the country nature fails to supply enough water, and irrigation or dry farming is practiced. In the more humid regions, however, there is often too much moisture, and it becomes necessary for man to provide some way by which the excess moisture may be promptly removed, else the crops will be injured.

The kind of land that should be drained. In all soils there are two kinds of water: (1) film water and (2) free or ground water. If a boy plunges his finger into a pail of

water and pulls it out quickly, the moisture that adheres to it is known as film water. Round each particle of soil there is a similar coating of moisture known as film water. This is the kind of water used by plants. The water that occupies the spaces between the particles of soil is known as free, or ground, water. The level at which the free water stands in the soil is known as the "water table." Sometimes it is near the surface and sometimes it is many feet below. The height of the water table can be determined by digging a hole in the ground to such a depth that water stands in the bottom. It is this free water which supplies dug wells and springs. Any soil in which the water table remains close to the surface should be drained. This condition often prevails in river-bottom soils, swampy land, and level prairie soils. Upland or rolling clay soils, especially if underlaid with an impervious subsoil, usually have a high water table, and are therefore greatly improved by draining.

Advantages of good drainage. The primary purpose of drainage is to remove the excess free water and thus lower the water table to a sufficient depth so that the plants may take deep root. Experiments have shown that the roots of our ordinary crop plants do not penetrate the soil below the surface of the water table, and the feeding space, therefore, available to them is limited by the height of the water table. Moreover, excess water makes a soil cold, for more heat is required to raise the temperature of water than is required to raise the temperature of an equal weight of dry soil. If land is not well drained naturally, then it should be drained artificially, preferably by the use of tile. The drains benefit soils in several ways. They help to remove excess water after heavy rains, and thus tend to prevent surface washing. By removing the surplus water down through the soil, air is drawn into the soil, and this not only aërates, but tends to hasten the decay of organic matter and to warm up the

FIG. 136. *Preparing a drain with a ditching machine*

soil. The soaking of warm spring rain down through the soil also tends to raise the temperature of the soil, because the temperature of such rain water is usually warmer than is that of the soil. By raising the temperature, drainage virtually lengthens the growing season, promotes nitrification, lowers the water table, and thus encourages deep root growth which enables plants to withstand drouth.

Methods of drainage. Hard-burned clay tile systematically and carefully laid is one of the most satisfactory

ways to dispose of excess water. The size of the tile and the depth and distance apart of the drains will vary with the soil conditions. As a rule, the deeper the tile the farther apart the drains may be laid. Three-inch tile laid about two and one-half feet deep in laterals two or three rods apart is quite common in clay soils. In more porous soils the drains may be deeper and farther apart. If the location of the drains can be told by the appearance of the crop, then more laterals should be put in. On some types of soil an impervious subsoil comes close to the surface, and in such cases drainage by means of surface ditches is probably preferable to tile. The drains should be so planned as to provide for ample fall — not less than 2 to 4 inches for each 100 feet. The grade can be accurately established by means of ditching machines which are now generally used with good satisfaction.

TILLAGE

Definition. "Tillage" is a broad term, but, in general, it is used to indicate any operation by which soil is stirred or pulverized by the use of ordinary farm implements such as the plow, harrow, cultivator, cultipacker, etc. The purpose of tillage is to put the soil into a suitable condition for the growth of cultivated crops. Tillage modifies the physical and chemical properties of the soil, promotes bacterial development, conserves moisture, and kills weeds.

Tillage increases the food supply of plants. One of the most striking results of tillage is that it pulverizes the soil. This is important because it not only enables the tender rootlets to penetrate more easily into the soil, but the greater number of more finely divided soil particles present a much greater feeding surface to the roots. The stirring of the soil also brings about chemical changes which result in an increase in the food supply.

Tillage admits air to the soil. Tillage loosens the soil, and the spaces between the particles of soil become filled with air. Plants cannot grow unless they have air around their roots the same as around the parts above ground. Perhaps you have noticed the unthrifty condition of corn or oats growing in wet, poorly drained spots in a field. The

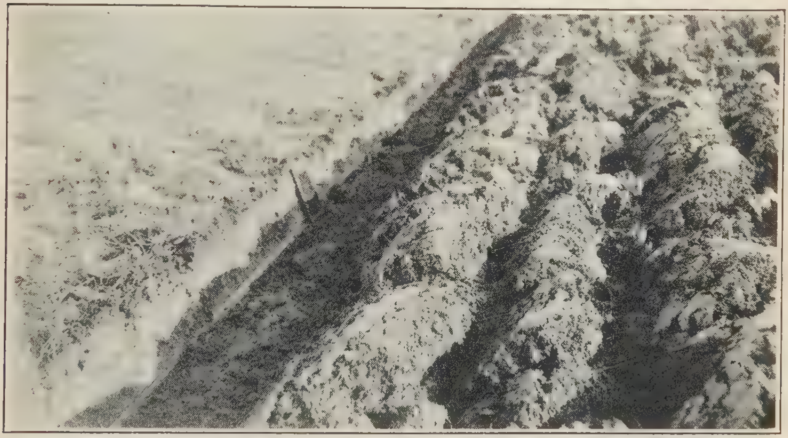


FIG. 137. *Proper depth of furrows*

water itself is not injurious to the plants, but the sickly yellow appearance is due to lack of air, which is excluded by the water.

Tillage provides a hospitable home for soil bacteria. Attention has already been called to the fact that soils contain organic matter, or humus. Before the nutrients contained in this material can be used by plants, it must be decomposed. This work is done by myriads of little organisms known as soil bacteria. They are too small to be seen by the naked eye, but they cannot live and work without air any more than people can. Moreover, the organisms which enable leguminous plants to derive free nitrogen from the air are also dependent on the presence of air around the roots of plants. Since good tillage promotes the aeration

of the soil, it is therefore helpful not only in liberating the nutrients contained in the organic matter, but it aids indirectly in securing free nitrogen from the air.

Tillage increases and conserves soil moisture. As the soil is pulverized and broken up through tillage, the number of soil particles, and consequently the surface area, is increased. The increase in surface area means an increase in available

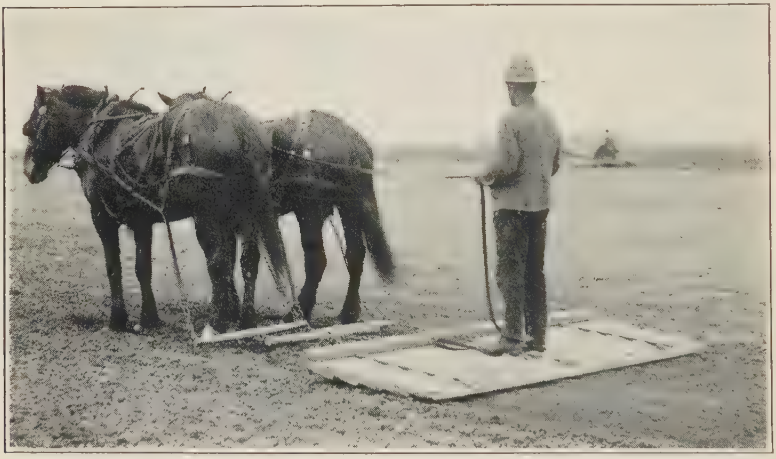


FIG. 138. *A drag or float for leveling the field*

soil moisture, for, as has already been stated, it is the film water only that can be used by plants.

Tillage may also conserve as well as increase the water supply. In a closely packed soil, moisture rises from the lower levels to the surface, is evaporated by the wind and sun, and passes off into the atmosphere. Much of the loss may be prevented if the surface of the soil is covered with some material such as straw or boards. Perhaps you have noticed that the ground is usually quite moist under boards. The same result may be obtained by stirring the surface of the soil two or three inches deep, and thus establishing what is known as a dust mulch. Moisture cannot readily rise

through the loose layer of earth, and so loss by evaporation is prevented. To maintain a dust mulch, the ground should be stirred frequently, preferably after each rain.

Tillage in relation to weed control. Weeds take from the soil moisture and plant nutrients the same as do the desirable cultivated plants. Therefore if they are allowed to grow unchecked they utilize much material that would otherwise be available for the use of cultivated crops and to that extent restrict the growth of them. This loss may be prevented by cultivating frequently enough to kill the weeds.

ROTATION OF CROPS

What is meant by rotation of crops? The growing of different kinds of crops in a definite order or succession on a given piece of land is known as a rotation of crops. Manifestly, the length of the rotation will vary according to the number of crops involved. For example, it may be a three-year rotation such as potatoes, wheat, and clover; or a five-year rotation such as corn, oats, wheat, clover, and timothy.

The importance of rotating crops. Just how or when or by whom it was discovered that crops yield better when grown in rotation than when one crop is grown continuously on the same land, is not known. However, we know from history that belief in this practice has prevailed among farmers for many centuries, and in recent years the value of the procedure has been demonstrated frequently by experimental evidence. For example, on the farm of the Ohio Agricultural Experiment Station, corn has been grown on a certain piece of land every year continuously for thirty years. On similar land, adjoining the continuous test, it has been grown for the same period of time, but in a five-year rotation of corn, oats, wheat, clover, and timothy. As an average of the last five years in the thirty-year period, the corn yielded 16.9 bushels

per acre in the continuous cropping, and 54.1 bushels per acre in the rotative cropping.

Some of the reasons for rotation. *The food requirements of plants are unlike.* A crop of corn and a crop of timothy require practically the same amount of potassium, but the corn crop requires approximately twice as much nitrogen and nearly three times as much phosphorus as does timothy. From this comparison, it is apparent that the soil's supply of phosphorus would be depleted much sooner by corn grown continuously than it would by corn grown in rotation with other crops such as timothy.

Deep-and shallow-rooted plants. The root systems of crop plants are quite unlike one another. Some, such as oats and wheat, have comparatively shallow roots, while others, such as alfalfa and most of the clovers, have a taproot which may penetrate the soil to a depth of several feet. The deep-rooted plants not only derive food from the lower levels, but they bring it to the surface and upon their death and decay leave it where it is available for the use of other plants.

Soil is improved by rotation. Anyone who has ever undertaken to cultivate land which has long been devoted to the culture of one crop is soon impressed by the fact that it is comparatively tough and heavy and more or less difficult to work. Continuous cropping depletes the organic matter, and the soil becomes hard. It lacks life. The growth of soil organisms is dependent on an abundance of organic matter.

Aids in controlling diseases and insect pests. Certain diseases, such as potato scab and club root in cabbage, cause great damage to crops that are grown continuously on the same land. The microörganisms which cause the diseases live in the ground from year to year if the same crop is grown, but if other crops are introduced and grown for a few years, the injury is materially reduced.

Likewise insects which live on certain plants, and which are unable to migrate from field to field, may be starved out if the land is used for several years to grow other crops.

Rotations subdue weeds. Not all weeds can be controlled by the same methods. The cultivation required for the growing of any one crop may not be such as to control a given weed, whereas if the same weed is subjected to the various cultural methods required by a variety of crops, it might be held in check, or even eradicated. Canada thistles, for example, are hard to control in a meadow where they are mowed once a year, but if the same field is used in a rotation including cultivated crops such as corn or potatoes, the thistles may be killed.

Rotations keep land and labor busy. If one crop is grown year after year, the land is unoccupied for a considerable part of the time. This may result in the loss of much fertility, and it fails to provide for the use of labor throughout the season. Land used for the growing of corn might lose much fertility during the fall months if it is left unoccupied.

Rotations free soil of poisonous substances. By some people it is thought that the poor yields obtained in continuous cropping are due to poisonous substances given off by the roots of plants. Although the substances may be poisonous to the crop itself, they are thought to be harmless to other species of plants.

GREEN MANURING

What is meant by green manuring? Ordinarily a crop is grown for the proceeds or products of the crop itself. Corn, for example, is cultivated primarily for the grain it will produce. A crop such as clover is grown for the forage that may be obtained. Sometimes a crop, usually one such as rye or sweet clover, is grown to be plowed down to improve

FIG. 139. *Green manuring. Field peas are being disked into the soil*

FIG. 140. *Green manuring. Rye is the surest crop in the North*

the fertility of the soil. The growing of a crop for the purpose of enriching the soil is known as green manuring.

Humus important for production. As has already been mentioned, all soil contains partially decayed plant and animal refuse known as humus. The higher the humus

content of the soil, the darker is its color. It is well known that black soil usually produces much more than light-colored soils. Ordinarily, new soils contain much more humus than do older ones, and undoubtedly that is one important reason why they are so much more productive. Experience has shown, however, that unless some attention is given to maintaining the humus supply, the fertility of new soils is soon depleted by continued cropping.

Benefits from humus. Humus is important in the soil because (1) it conserves soil moisture, (2) it improves the physical condition, and (3) it serves as a storehouse for plant food. It is in this material that much of the soil nitrogen as well as the more readily available phosphorus and potassium is contained.

Keeping up the supply of humus. Green manuring is often practiced in order to maintain the humus content of the soil. For this purpose leguminous crops are most useful, because they actually add some fertility to the land. This they can do because of a peculiar relationship they are able to establish with microörganisms or bacteria which develop on their roots. In these the bacteria live, and as a result of their presence nitrogen is taken from the air and added to the soil. Plants on the roots of which nodules have developed are said to be inoculated. A well-inoculated soy-bean plant is shown in Figure 146, page 274. The gathering of nitrogen from the air is very important, because nitrogen is the most expensive element purchased in commercial fertilizers.

Nonlegumes such as rye are frequently plowed under. Such crops improve the physical condition of soil, and they tend to liberate plant food already in the soil, but, unlike legumes, they do not add any fertility.

Green manuring not always a good practice. In a dry season the growing of a green manure crop may result in

robbing the following crop of needed moisture. This is often the case where a heavy crop of rye is plowed under in late spring, to be followed by some such crop as corn or potatoes. Furthermore, in a dry season the decomposition of such a crop after it is plowed under takes place slowly. This may interfere seriously with the capillary rise of water and thus injure the succeeding crop.

The purpose of the various operations thus far considered —drainage, tillage, and green manuring—is to liberate or make available the constituents of the soil. Since large quantities of many elements are removed by the growing of the crops, manifestly something must be put back if the fertility is to be maintained. We are now ready to consider the more important ways by which fertility is added to the soil.

BARNYARD MANURE

Production. The amount and composition of manure produced on a farm will vary with many factors, such as the kind and age of the animals, the kind of feed and bedding used, the methods employed in handling, etc. On the majority of farms, most of the manure is produced from feeding horses, cattle, sheep, and hogs. Experimental evidence indicates that for each 1,000 pounds of live weight, a farmer may expect each year approximately 8 tons of horse manure, 13 tons of cattle manure, 6 tons of sheep manure, and 10 tons of hog manure.

Manure made by young, growing animals such as calves and colts is not so good a fertilizer as is that made by mature animals, especially fattening stock. Young animals take from the feed consumed a greater proportion of nutrients than do older ones because these nutrients are required in the formation of bones, muscles, flesh, and blood.

The kind of feed given to stock affects the quality of manure. Animals to which is fed an abundance of highly nitrogenous feeds such as bran, cottonseed meal, clover, or alfalfa will produce a higher grade of manure than would those receiving less nutritious feeds such as timothy hay, corn stover, etc.

Preservation of manure. Manure consists of solid and liquid excrement, and about one-half of the fertilizing constituents is contained in the liquid. Moreover, the liquid is the best part of the manure, because the plant food contained in it is in a form already available to the plants.

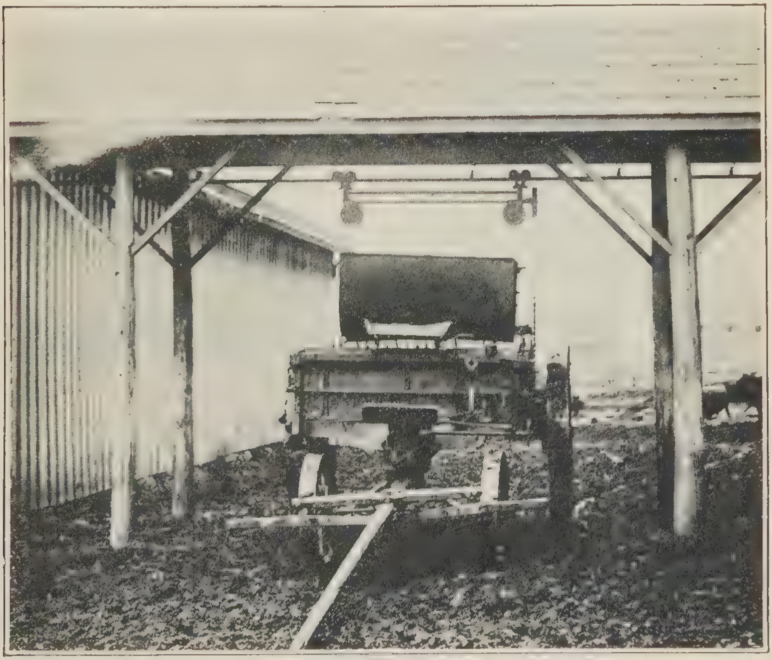


FIG. 141. *A convenient manure shed*

Before that contained in the solid excrement can be used by plants it must be further decomposed. In the handling of manure, therefore, it is important to save the liquid.

A tight barn floor or cement stable is essential. In a feeding test carried out at the Ohio Experiment Station, a group of steers was divided into two lots, one being fed on a dirt floor and one on a cement floor. In six months of winter feeding the value of the manure made on the cement floor was worth enough more than that made on the dirt floor to pay for more than half the cost of cementing. The loss of much liquid may be prevented by the liberal use of bedding, such as straw or shredded corn stover.

Losses in manure. Manifestly it is of little avail to preserve the liquid excrement in the stable if later the manure is to be thrown into a pile in an open barnyard, for under such conditions it is exposed to loss of two kinds — leaching and hot fermentation. Perhaps you have noticed the stream of brown liquid flowing from the manure pile in an open barnyard after each heavy rain. This is mute evidence of leaching, and experiments have shown that the loss may amount to one dollar or more for each ton.

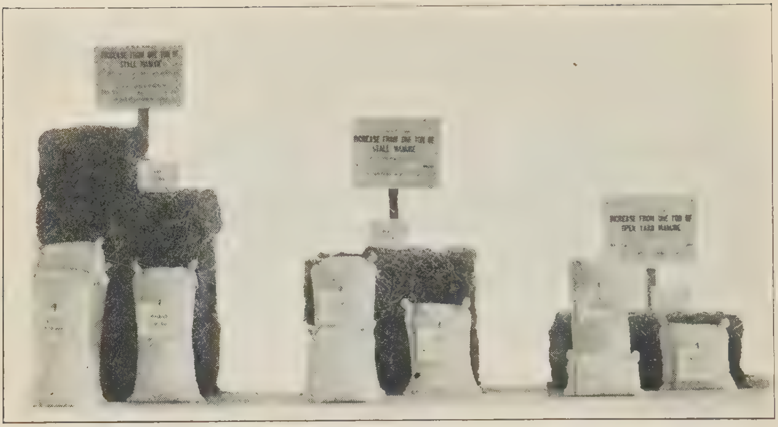
On the other hand, if the manure pile becomes too dry it may heat, and this also results in loss. The odor of ammonia often noticed in the vicinity of a manure pile is evidence of the escape of nitrogen.

Application of manure. To avoid loss from either leaching or hot fermentation, it is best to haul manure directly from the stable to the field from day to day as it accumulates during the winter, and scatter it with a good manure spreader. Some leaching may occur, but unless the ground is very rolling and hilly, the liquid will soak into the ground where it is needed and little will be lost. Manure may be scattered as a top dressing on wheat or on new meadows, but it is best applied to sod ground which is to be planted to some cultivated crop like corn. If the quantity is limited, a greater return will be realized from a thin application made over all the

FIG. 142. *Upper picture shows the modern way of spreading manure; lower picture, the old way*

land than from a thicker application made on a part of the land.

Reinforcement of manure. While manure is one of the oldest and best of fertilizers, it is not altogether satisfactory because it is not well balanced. As a rule each ton contains about 10 pounds of nitrogen, 3 pounds of phosphorus, and 8 pounds of potassium. You will note the relatively low amount of phosphorus. It so happens that many of our soils, especially those which have been under cultivation for many years, are relatively deficient in this same element,



a b c

FIG. 143. *Increased yield from (a) stall manure plus acid phosphate, (b) stall manure alone, and (c) yard manure alone*

No phosphorus: 51% plump kernels

Phosphorus: 88% plump kernels

FIG. 144. *Phosphorus makes wheat kernels plump*

phosphorus. The effectiveness of manure, therefore, may be greatly increased by reinforcing it with some carrier of phosphorus. At the Ohio Experiment Station a test has been carried on for more than twenty-five years in which manure has been reinforced with acid phosphate. The treatment has almost doubled the value of the manure.

COMMERCIAL FERTILIZERS

Experiments have shown that approximately 80 per cent of the nutrients contained in grain and hay fed to live stock may be recovered in the manure, assuming that none is lost

FIG. 145. *Manure boosts the yield of hay. Manure, left, 2.9 tons per acre; nothing, right, 0.7 ton per acre*

through careless handling. However, it is known that approximately one-half the value may be lost if it is exposed to the weather three or four months in an open barnyard. To offset these losses it is necessary to supplement barnyard manure with commercial fertilizers if the fertility of the fields is to be maintained.

Fertilizing elements. As has been stated already, plants require for their growth and development ten different chemical elements, part of which come from the soil and part from the atmosphere. Of those derived from the soil there is, with few exceptions, an abundance of all except three — nitrogen, phosphorus, and potassium. To reinforce

some one or all of these is the reason farmers use commercial fertilizers. For that purpose they now expend annually in the United States about $125,000,000.

Carriers of elements. The nature of fertilizing elements is such that they cannot well be handled in a pure state. Nitrogen, for example, is a gas, and manifestly it could not be distributed with a fertilizer drill. However, an element may combine chemically with one or more other elements, thus forming various compounds. These are easily handled. The compounds which contain a given fertilizing element are frequently spoken of as "carriers" of that element. For example, nitrate of soda is a carrier of nitrogen.

Commercial carriers of nitrogen. The principal carriers of nitrogen are (1) nitrate of soda, (2) sulphate of ammonia, (3) tankage, and (4) materials synthesized from atmospheric nitrogen, such as cyanamid, ammonium nitrate, and nitrate of lime. Nitrate of soda, sometimes called Chile saltpeter, is imported from Chile, South America, where extensive deposits of the salt are found. Sulphate of ammonia is a by-product obtained in the manufacture of illuminating gas. Tankage, a by-product of slaughterhouses, is made from scraps of meat and tendon from which the grease has been removed by cooking in vats.

FIG. 146. *Soy-bean nodules, a source of nitrogen*

Nitrogen is easily lost and wasted from the soil, and frequently, therefore, it is the element most needed to increase or even to maintain crop yields. Unfortunately

FIG. 147. *Commercial fertilizer helps the hay crop. Complete fertilizer, left, 1.6 tons per acre; unfertilized, right, 0.6 ton per acre*

it is the most expensive of all the constituents bought in commercial fertilizers. Therefore the more successful farmers aim to get a large part of their nitrogen from the atmosphere, which contains an inexhaustible supply — about seventy million pounds over each acre. This they can do by growing and occasionally plowing down nitrogen-fixing legumes such as the clovers, alfalfa, soy beans, cowpeas, field peas, or the vetches. For this purpose sweet clover is especially valuable.

Commercial carriers of phosphorus. There are three principal sources of phosphorus: (1) rock deposits, (2) the bones of animals, and (3) slag. By far the larger part comes from the rock deposits, enormous beds of which are found

in many of the southern and western states. The raw rock does not give immediate results unless used in large quantities or in connection with decaying organic matter. In order to make the phosphorus readily available, the finely ground rock is treated with sulphuric acid, and the resulting product is the 16, 20, or 24 per cent acid phosphate of the fertilizer industry, the percentage varying with the purity of the original rock.

The bones of animals are rich in phosphorus, and for that reason they are ground up and sold as fertilizer. There are two products: (1) raw bone and (2) steamed bone. Steamed bone differs from raw bone in that it has been steamed in order to remove the flesh.

Slag is a by-product obtained in the manufacture of steel.

Commercial carriers of potassium. The principal sources of potassium are (1) muriate of potash, (2) sulphate of potash, and (3) kainit, all of which are found chiefly in Germany and imported into this country. Muriate of potash is the carrier in most common use, and in this form the potassium is slightly less expensive than it is in the sulphate of potash. Kainit is a mixture of muriate of potash and common salt. It is not extensively used.

Prior to the World War these salts were the chief source of potash used in this country. During the war some natural deposits were found here and partially developed. Since the war the development of the home supplies has been continued, but the cost of production is still too high to compete successfully with the German salt. Consequently the bulk of our potash is now coming from Germany, just as it did before the war.

Mixed fertilizers. Many soils, particularly the poorer ones, respond best to the use of fertilizers carrying all three elements — nitrogen, phosphorus, and potassium. Such fertilizers are made by mixing carriers of the different

elements and the product is known as a mixed or complete fertilizer, and is usually labeled as a 2–8–2, a 3–12–4, etc., the three figures referring to the quantity of nitrogen, phosphorus, and potassium respectively.

Liming the land. Most soils contain enough lime to satisfy the nutritive needs of the plants. However, there are many soils on which certain legumes do not thrive well. These are usually soils underlaid with sandstone or shale. Such soils can be improved to the extent that legumes will grow on them by the addition of lime.

What the lime does. Lime benefits the soil indirectly in several ways. It improves its physical condition, liberates plant food, and neutralizes the acidity. If in the making of mud balls a little lime is added to one and not to another, it will be found that the former will crumble and break up much more easily than the latter. Lime has a similar effect when applied to heavy clay soils.

If lime is added to a little concentrated manure, soon the odor of ammonia may be detected, thus showing that lime liberates other elements of plant food. It acts the same way in the soil; therefore in the use of lime provision must be made for keeping up the supply of organic matter through applications of manure or by green manuring. Failure to do this in the early use of lime is probably what gave rise to such proverbs as:

"Lime enriches the father, but impoverishes the son."

"Lime, and lime without manure,
Will make both farm and farmer poor."

Probably the most important function of lime is to neutralize acidity. As the organic matter of the soil decays, acids are formed, which, in the absence of an abundance of lime, interfere with the development of desirable soil organisms such as those which live on the roots of plants like clover and alfalfa.

FIG. 148. *Sweet clover requires lime*

FIG. 149. *Lime makes clover grow. Limed, left, 1.7 tons per acre; unlimed, right, 0.7 ton per acre*

Indications of lack of lime. The behavior of red clover is a good index. On sour land the stand of clover may appear to be even when the wheat is removed, but, as the

season advances, it dies out here and there. Finally the entire field may become patchy. Where the clover dies out, other plants, such as sorrel, usually come in. If this kind of situation develops year after year, one should be suspicious that the soil needs lime. Further evidence can be obtained by making one of the many simple field chemical tests. Your experiment station or your county agricultural agent will furnish on request directions for making such tests.

If lime is found to be lacking, it should be applied promptly. Dr. Thorne says: "When the land begins to need lime it is a waste of time, energy, and money to continue cultivating it until the need is supplied, for the economical use of every other fertilizing material, including manure, depends on the lime supply. If that is deficient, everything else must fall short of its possible attainment."

FIG. 150. *Spreading lime*

Application of lime. The term "lime" is applied to a great variety of products, which are offered on the market under many different names, such as limestone, burned lime, hydrated lime, marl, etc. Any of them should be bought on the basis of its neutralizing power, which in most states may be learned from the state department of agriculture.

The quantity required per acre will vary, but ordinarily two tons of limestone or its equivalent is regarded as a good application. It is best distributed with a lime spreader. The preferable point in a rotation at which to make the application is on the corn ground after it is plowed. However, it can be applied satisfactorily to other crops and at other seasons of the year, as, for example, in the late fall or winter, on sod which is to be plowed for corn in the spring.

QUESTIONS

1. Name the principal agencies in the formation of the soil.
2. Name the different kinds of soil according to geological classification; agricultural classification.
3. What is the difference between soil and subsoil?
4. On what kinds of soil is drainage advisable?
5. What is the water table?
6. What is meant by tillage?
7. Name four ways in which tillage is beneficial.
8. What do you understand by rotation of crops?
9. Name five advantages of rotating crops.
10. For what purpose is green manuring practiced?
11. Is it advisable in all seasons? Why?
12. On what does the value of barnyard manure depend?
13. Name two ways in which losses in manure occur. How can these losses be overcome?
14. What is one of the best ways to handle manure?
15. Why is the use of commercial fertilizers necessary?
16. What are the three principal constituents of commercial fertilizers?
17. When should one be suspicious that a field needs lime?
18. In what ways does lime benefit soils?
19. What products are included in the term "lime"?
20. To what crop would you prefer to apply lime?

PROJECT LESSONS

Exercise I

Object. To show that water clings to the soil particles.

Materials. Old coffee can, cheesecloth, air-dry soil, and water.

Procedure. Tie the cheesecloth over the perforated bottom of the can. Fill the can nearly full with soil, and pour on it a measured quantity of water. Allow the can to drain. Did all of the water come through? What is the water called that did come through? What is that called that remained in the soil?

Exercise II

On the basis of the figures given on page 268 calculate the number of tons of manure produced on the home farm last year.

Exercise III

Object. To note the effect of fertilizer on the growth of plants.

Materials. Two one-gallon flowerpots, clean sand, and a little commercial fertilizer.

Procedure. Fill the two jars with sand, settling it by jarring until the sand is within one-half inch of the top. To one jar add five grams of a high-grade fertilizer, one analyzing about 3-12-4. Mix it thoroughly with the surface soil to a depth of three or four inches. Plant four grains of corn in each pot. Moisten the sand and set the jars in a warm place in the sunlight. Keep the sand moistened and observe the amount of growth made in four to six weeks.

Exercise IV

Object. To find out if a field needs lime.

Materials. Litmus paper (this can be obtained from a drug store) and a clean knife.

Procedure. Make an incision into the soil with the knife. Insert a piece of litmus paper. Pack the soil tightly against the paper. (If the soil is dry moisten it with soft water.) Allow it to stand four or five minutes, then carefully remove the paper. A pink color indicates acidity, or a need for lime. A blue color indicates no need for lime. The test should be made six or eight times in representative parts of the field.

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CHAPTER XXII

WEEDS

What is a weed? The accepted notion is that weeds are plants growing where they are not wanted. Cornstalks in a pansy bed, lilac sprouts in a lawn, wild roses in oats, are weeds. Although most weeds are herbs—that is, die down to the ground each year—foresters recognize weed trees, undesirable kinds of trees which they remove from the forest. Accordingly weeds include herbs, shrubs, and trees.

Why a weed? (1) Weeds usurp the space of, and crowd out, crop plants. This is most noticeable in lawns. (2) They rob the soil of water and plant food. Redroot or pigweed, a large-rooted common weed, robs the soil of nitrogen. (3) They may be parasites on crop plants, as dodder on clover. (4) They increase the work and cost of harvesting, as morning glories or thistles in grain. (5) Some weeds are poisonous to animals and man. White snakeroot, water hemlock, cockleburs, corn cockle, and poison ivy are common poisonous weeds. (6) Wild garlic and sweet clover in wheat taint the flour. Wild garlic seeds gum the rolls of flour mills and add to the milling expense. Wild garlic in pastures or hay taints milk and butter. (7) Burs—spiny or prickle seeds—reduce the market value of wool. They pierce the hides of sheep and render them unfit for leather. (8) The beards or awns of weed grasses injure the mouths, throats, eyes, and feet of cattle and sheep. They may pierce the lungs or intestines and cause death. (9) Weedy hay must be sold cheaper than clean hay. (10) The presence of weed seeds lowers the market value of crop seeds. (11) Weeds are hosts to fungi which also attack

farm crops and cause disease. (12) They harbor insects which attack crops. The European corn borer infects 185 different kinds of plants, including barnyard grass, cocklebur, pigweed, burdock, and other thick-stemmed weeds of cornfields. (13) Ridding land of weeds increases the difficulty and cost of farm labor. (14) Because of the foregoing, weeds reduce the market value of farm land. It has been estimated that the annual loss to farms due to weeds is $2.00 per tillable acre in Pennsylvania, an estimated total loss of $24,000,000 to the state, or $3.00 for each person.

Some weeds are beneficial. A number of weeds are good honey producers. Medicines are obtained from several common weeds. Weed seeds furnish food for birds. Sparrows are fond of dandelion seeds. Sunflowers and sweet clover are now grown for forage. Rabbits are fond of dandelion leaves. Weeds of the bean family develop root tubercles which are a source of nitrogen to the soil. Quack grass, a pest in cultivated fields, prevents soil from washing and may be effectively used on embankments. This is due to its tough branching underground stems.

Classification of weeds. *Annuals* produce seed during the first year of their lives and then die. The life span covers only one growing season. The seeds of some annuals sprout in the late summer or fall. The plants remain alive over winter and seed the next summer, such as whitetop and chickweed. These are called winter annuals.

Biennials produce a rosette of leaves and a thickened root the first year, an elongated flower and seed-producing stem the second, and then the entire plant dies.

Perennials live indefinitely and may produce seed every year. The entire plant except the flowers may be perennial. But in most cases the stems and roots are perennial, while the leaves and flowers are annual.

Propagation. *Annuals* and *biennials* are propagated by seeds only. *Perennials* are propagated by seeds and by sprouts from roots and stems.

Dissemination. The principal agents by which weed seeds are scattered are wind, water, animals, man, freight cars, ships, trucks, threshing machines, and explosive seed pods.

Dandelion, thistle, and milkweed seeds have tufts of plumose hairs which act as parachutes by which they float often for miles in the air. The entire dry plant of the tumbleweed and Russian thistle breaks off at the ground and scatters its seeds as it rolls along with the wind. Flooded fields often acquire many more, and frequently new, weeds.

Animals and man are instrumental in scattering seeds and seed pods whose barbs, spines, or prickles imbed themselves in the hair, wool, or clothing, and may be carried appreciable distances before they are dislodged. Water birds carry weed seeds or entire plants on their webbed feet, to be washed off when the birds rest and feed.

Weeds from distant states or foreign countries frequently appear along railroad tracks, in stockyards, circus grounds, or at ship docks, having been brought there and dumped in the bedding of animals in transport.

Touch-me-not, or jewel weed, and wild geraniums have explosive pods from which the seeds are thrown out from the parent plant.

An avoidable means of disseminating weed seeds is as a contamination of grass, clover, alfalfa, and even grain seed. By its weed seeds we are sometimes able to determine the source of crop seeds.

Legislation against weeds. Noxious weeds are those which multiply so fast, are so difficult to exterminate, or are otherwise so detrimental as to be considered pests.

The various state legislatures have enacted weed laws which list the plants considered noxious in that state, prohibit their introduction, provide for their extermination, and prescribe penalties for failure to observe the law. An important feature of these laws is the recognition of the importance of the introduction and sale of seed free from noxious weed seeds.

In Figure 151 are illustrated the seeds of nearly all the weeds declared noxious in the pure seed laws of the north central and middle western states. An enlarged and natural size view is given of seeds, seed pods, and, for wild garlic, the bulblets.

Weed control. The use of clean, weed-free seed is an important preventive measure. Clean seed not only insures clean crops, but saves much labor and expense. It is noteworthy that the majority of our worst weeds have been introduced from a foreign country as impurities in crop seeds. The weeds native to the United States are also scattered from one section to another in the same way.

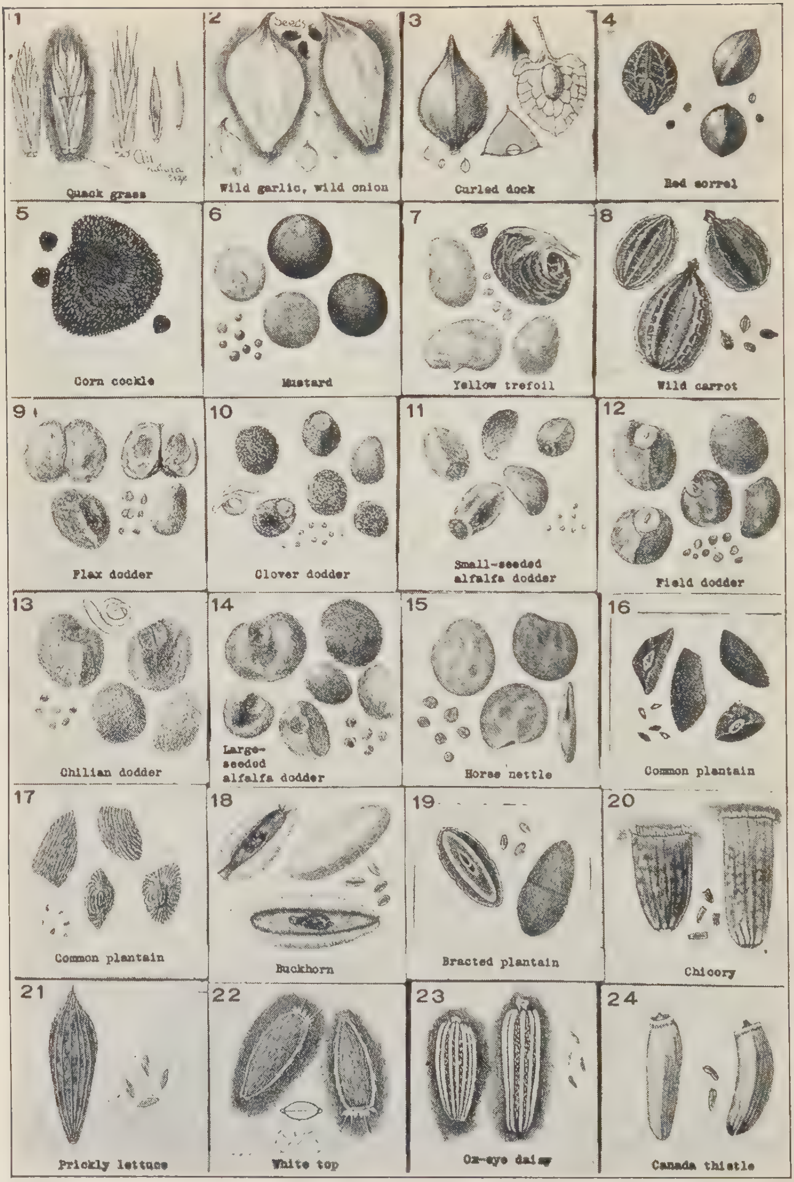
In order to reduce this evil, state seed laws require that all lots of agricultural seeds shall bear on the label the name of each kind of noxious weed seed or bulblet present in excess of a certain stated percentage and the approximate total percentage of weed seed.

Weeding, *digging*, *grubbing*, or *plowing*, by which the entire plant is removed, are the most thorough ways to exterminate weeds. This is often impracticable and other means must be used.

Mowing or *clipping* before the plant blooms or seeds ripen is all that is necessary to exterminate annuals and biennials and is helpful in controlling perennials.

Close cropping of pastures is of the same nature. Salting the weeds will attract grazing animals.

Shallow cultivation, using a cultivator provided with knife



Courtesy F. H. Hillman, United States Department of Agriculture

FIG. 151. *Seeds of noxious weeds*

or sweep blades in place of the ordinary shovel blades, or cutting with spud or hoe just below the surface of the ground is still more effective.

Hog pasturing. The hedge or great bindweed and the wild sweet potato vine have large fleshy roots of which hogs are fond and for which they will root thoroughly, quite effectively ridding the field of these weed pests.

Rotation of crops helps to kill weeds. A rotation including a smother crop like alfalfa is effective. Weeds as well as other green plants need air and sunlight. Dense shading, therefore, tends to weaken and to kill them.

Noxious weeds. The six plants of which pictures are given in Figures 152 to 157 are among the more troublesome weeds wherever they occur, and are declared noxious in the various state laws. They are generally distributed throughout the eastern, central, northern, and middle western states. They are regarded as noxious for various reasons.

Quack grass is noxious because it is difficult to exterminate on account of the numerous, vigorous, branching, spreading, tough underground stems from which shoots are freely and abundantly produced. These stems or rhizomes go deep into the ground, especially in cultivated fields. Although a pest in plowed ground, as a forage plant quack grass is palatable, nutritious, hardy, leafy, easily harvested, and will grow in almost any kind of soil.

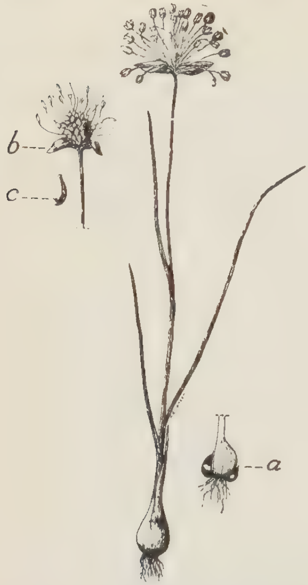
It is used in medicine under the name of dog grass. The fluid extracted from the underground stems is used in kidney and bladder diseases.

Wild garlic is noxious because it taints flour, milk, butter, and eggs, and because it is difficult to exterminate.

It has five different means of propagation:

1. Soft-shelled bulbs. Each plant produces one, sometimes two, ordinary bulbs covered with soft white scales. These have been called soft-shelled bulbs.

2. Hard-shelled bulbs. Between the scales of the soft-shelled bulbs are produced a number of smaller bulbs cov-



Courtesy Purdue University Agricultural Experiment Station, Lafayette

FIG. 152. *Wild garlic, a tufted, onion-like perennial with white to pink flowers. Height, 6–30 inches*

Courtesy Purdue University Agricultural Experiment Station, Lafayette

FIG. 153. *Quack grass, a matted, slender, wheat-like perennial grass. Height, 1–3 ft.*

ered with hard, straw-colored, shell-like scales. These are known as hard-shelled bulbs.

3. Aërial bulblets. Garlic plants bear heads of small bulbs which, at maturity, are about the size of grains of wheat and are very difficult to separate from wheat. If sown with the wheat they become a means of dissemination.

4. Secondary bulblets. The aërial bulblets sprout in the fall. When the young plants are several inches high, minute secondary bulblets appear at the base of the primary. These also sprout and, soon separating from the primary bulblet, become independent plants.

5. Seeds. South of the Ohio River wild garlic is known to mature seeds. Mature seeds have been reported from southern Indiana, but they usually do not ripen north of the Ohio River.

Red sorrel is a pest in pastures and lawns, as it occurs in patches, crowding out other plants. As it is sour, stock will not eat it. Its numerous small seeds cannot easily be separated from clover and grass seeds. It is as impurities in such seeds that the plant is disseminated.

Courtesy Purdue University Agricultural Experiment Station, Lafayette

FIG. 154. *Red sorrel, an erect perennial. Flowers of female plants, reddish, of male plants, yellowish. Tops reddish in fruit. Height, 3 15 inches*

Courtesy Purdue University Agricultural Experiment Station, Lafayette

FIG. 155. *Canada thistle, a prickly, disagreeable perennial with purple flower heads. Height, 1–3 feet. A taller, slender-growing variety attains 4 feet in height*

Wild carrot is seldom troublesome in cultivated fields, as the cultivator cuts off the crown of the root and kills the plant. It does not sprout from the root below the

crown. It may become a pest in pastures and hayfields if its seeds are allowed to ripen.

Dodder is a serious pest in clover and alfalfa. Its seeds are about the size of clover and alfalfa seed, and hence are

Courtesy Purdue University Agricultural Experiment Station, Lafayette

FIG. 156. *Wild carrot, an erect, lacy-leaved biennial with umbels of small white flowers. Height, 6–36 inches*

Courtesy Purdue University Agricultural Experiment Station, Lafayette

FIG. 157. *Dodder, a slender, twining, twisting, yellowish, annual (occasionally perennial) parasite with clusters of small white or pink flowers. Length, 6–36 inches*

not removed in screening. Dodder is propagated by the seeds only, and as these may remain alive in the soil ten or more years, the prevention of seeding is a very important matter. Dodder grows in a tangled skein of slender yellow or orange threads over the host plants, making mowing difficult.

Canada thistle is the most noxious weed of the northern states from the Atlantic to the Pacific. It always grows in patches, because of the branching, ramifying, propagating root from which shoots may sprout from April until October.

These roots may lie from two to three feet deep and remain untouched by plow or cultivator. Patches of thistles crowd out all other plants. The weed infests all kinds of fields and grows in a wide range of soils. Its spiny leaves make it most undesirable in the harvesting of hay and grain and prevent its being cropped in pastures. The widely ramifying roots permit it to spread locally. It is disseminated by its seeds, which bear a tiny parachute of fine plumose hairs. Its seeds may be present as impurities in grass, clover, and alfalfa seeds. In this way it was probably introduced into the United States.

QUESTIONS

1. State four ways in which weeds are harmful.
2. Distinguish between annual, biennial, and perennial plants.
3. How are weeds propagated?
4. Name four agents of weed dissemination and state the way in which each agent operates.
5. What are noxious weeds? Why should laws be enacted against them?
6. Describe the methods of weed eradication.

PROJECT LESSONS

Exercise I

Object. To determine which of the common weeds are annuals, which biennials, and which are perennials.

Materials. A good specimen of different kinds of weeds and a weed manual.

Procedure. Consult manual regarding the life history of the weeds.

Exercise II

Object. To find out how common weeds are propagated and disseminated.

Materials. A specimen of various weeds and a weed manual.

Procedure. Consult manual regarding the habit of growth.

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Quackgrass. Farmers' Bulletin 1307, United States Department of Agriculture.

Weeds: How to Control Them. Farmers' Bulletin 660, United States Department of Agriculture.

Weed manuals from the state agricultural colleges and experiment stations and from the state department of agriculture, such as:

A Second Ohio Weed Manual. Bulletin 175, Ohio Agricultural Experiment Station, Wooster, Ohio.

Nineteen Noxious Weeds of Indiana. Circular 106, Purdue University, Lafayette, Indiana.

Pennsylvania Weeds. Bulletin 416, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania.

Seeds of Michigan Weeds. Bulletin 260, Michigan Agricultural Experiment Station, East Lansing, Michigan.

CHAPTER XXIII

FORAGE CROPS

Definition of forage. Any boy who helps with the "chores" after school knows that farm animals are fed in general two kinds of feed: (1) grains, familiarly known as concentrates, and (2) forage, or roughage.

Forage is known under a variety of names, depending on the way in which it is handled. If the forage crops are cut, cured, and fed in a dry state, the forage is known as hay, corn stover, or straw, depending on the nature of the material. (A dry corn plant is called corn fodder before the removal of the ear, and corn stover after the removal of the ear.) If the forage crops are cut and fed immediately in the green state, the forage is known as soiling crops. If the forage crops are cut in the green state and preserved in a silo, the forage is known as silage. If the forage crops are not cut at all but, instead, the farm animals are turned into the field and allowed to do their own harvesting, the forage is known as pasturage, and the field itself is a pasture.

LEGUMES

Two groups of plants. A great variety of plants are grown for forage purposes, but all of them may be grouped into two classes: (1) legumes and (2) nonlegumes, or grasses. Legumes may be distinguished from grasses because (1) they develop one-sided flowers and (2) they bear pods. An advantage in growing legumes is that they take nitrogen from the air, and when the whole plant or even the roots and stubble are plowed under, they add nitrogen to the soil and thus help in an inexpensive way to maintain the fertility of the soil.

Red clover. Probably the most universally grown and the most highly prized legumes are the clovers. This particular group of legumes is further distinguished from grasses by the odor of the flowers and the oval shape of the leaves. Grasses are characterized by odorless blossoms and by long narrow leaves.

FIG. 158. *Red clover head*

Origin. The early history of the clovers is not well known, but it is thought that red clover was brought to us from Europe about one hundred and fifty years ago. It is now widely distributed and, on account of the high favor in which it is held by farmers, this clover is now more generally grown than any of the others. Red clover is classed as a biennial, but it often lives longer than two years. Common, medium, and medium red are other familiar names for it.

Characteristics. If we were to go into a field and examine a red clover plant, we should find that it has a taproot from which many branches spring. The deep taproot is very useful to the plant in gathering plant nutrients and moisture, not only from the soil but from the subsoil. Since much of the moisture used by plants comes from the subsoil, undoubtedly the taproots are very helpful in periods of dry weather.

The upper part of the red clover plant consists of many stems, all of which rise from a crown. Each stem branches freely, and the branches in turn produce still other branches, thus forming a more or less bushy plant. Some

plants stand erect, while the stems of others recline on the ground.

The leaves are borne in groups of three at the end of a small stem or petiole. The leaves are dark green with a characteristic white marking. Both stems and leaves are hairy. The composite flowers, red to rose pink in color, are borne on the ends of the stems. Each clover head on the red clover plant may contain a hundred or more single flowers.

Culture. Red clover may be expected to succeed on any well-limed soil on which corn does reasonably well. The

FIG. 159. *An old-fashioned wheelbarrow seeder*

seed is sown either in the spring in wheat or oats as a nurse crop, or in midsummer alone without a nurse crop. The sowing of from 10 to 12 pounds per acre of high-grade seed is regarded as a full seeding.

Making clover hay. As a rule, clover hay of the best quality is obtained by cutting the crop when a few of the blossoms are just beginning to turn brown. Most of them should be just past the full-bloom stage. If they are

Fig. 160. *Drilling clover seed*

Fig. 161. *Stirring hay with a hay tedder*

allowed to stand much longer, many of the leaves will be lost in curing, and the quality of the hay will thus be materially reduced.

Frequently it seems desirable to save the second crop for seed, and in that event the first crop is usually cut a little

before the stage at which it yields hay of highest quality. If cut too early, however, the plants are sappy and more labor is required to cure the hay.

Clover-seed production. Clover seed is not produced in large quantities except in a few localities. Much depends on the weather. Good rains after the first cutting are required in order to start promptly the second growth. Then a period of moderately dry weather in which to develop and ripen the seeds is desirable. If there is a fairly uniform stand of normal heads averaging twenty-five to thirty seeds per head, a yield of one to two bushels per acre may be expected. A fairly accurate estimation of the probable seed production can be made as soon as the blooms are well developed.

Foreign seed. In recent years the demand for clover seed has exceeded the supply of the home-grown crop. To meet the demand, seed has been imported from many foreign countries. The seed from some countries is less hardy than is that from others. Undoubtedly many clover failures are traceable to the use of nonhardy foreign seed. Experiments have shown that good domestic seed is preferable, and that the best foreign seed is that imported from such countries as Canada, Chile, France, and England. Seed from Italy is not adapted for general use in the United States.

Stained seed. One of the provisions of the Federal Seed Act passed by the Congress of the United States, April 26, 1926, is designed to help farmers to distinguish between adapted and unadapted seed. This law requires that all imported clover and alfalfa seed must be stained. If stained 10 per cent *red*, it is either unadapted or of unknown origin and should, therefore, not be used. If stained 1 per cent *iridescent violet*, it is of Canadian origin and is safe to use. If stained 1 per cent *green*, it is of foreign origin and

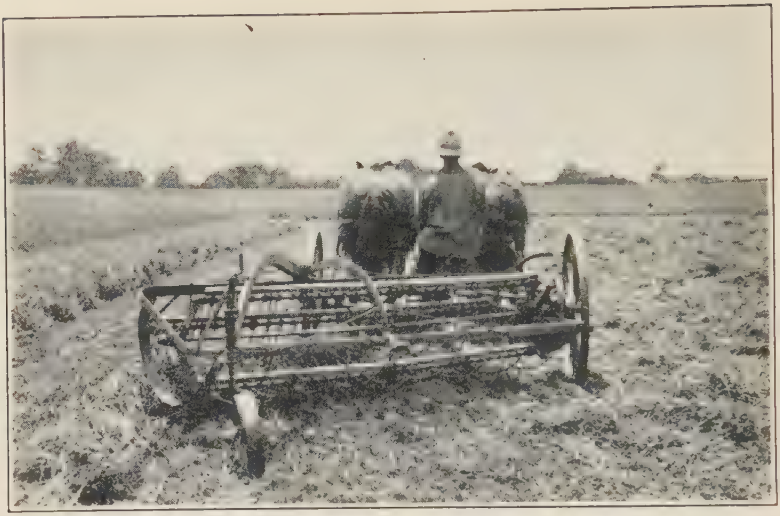


FIG. 162. *A side-delivery hay rake*

FIG. 163. *A hay loader saves much heavy work*

may or may not be suitable. Avoid clover and alfalfa seed stained red.

Mammoth clover. A clover closely related to the common red is the mammoth, sometimes called big or sapling

clover. In habit of growth the two resemble each other closely. In later life, however, the mammoth may be distinguished from the red by reason of the fact that it (1) grows taller and ranker, (2) matures three or four weeks later, (3) produces but one crop in a season, and (4) is more inclined than red clover to survive after cutting the first season. While it yields more than red clover, farm animals do not like the hay so well. It is most useful to plow under for the improvement of the soil.

FIG. 164. *Alsike clover*

Alsike clover. In habit of growth, alsike clover resembles closely the common red, but it is a finer type of plant, the root system being smaller and more fibrous, the branches fine and more slender, and the leaves and blossoms slightly smaller in size. The pink to white color of the flowers and the abundance of small leaves give it an appearance not unlike that of white clover. Unlike those of red clover, the stems are not hairy.

Eight pounds of seed per acre is regarded as a full seeding, but alsike is usually sown in mixtures except where the crop is wanted for the production of seed. The addition of alsike to the seed mixture is desirable when the land on which the crop is to be grown is poorly drained or somewhat acid. In feeding value alsike compares favorably with red, and on

soils deficient in limestone the yields are as good or better. If allowed to become overripe many of the leaves shatter off in the handling of the hay.

Crimson clover. Unlike those of red clover, the main stems of crimson clover give off relatively few branches,

FIG. 165. *Crimson clover plant*

FIG. 166. *White sweet clover*

thus giving the plant a less bushy appearance. At the top of each slender hairy stem is borne a cone-shaped head of bright crimson flowers from which it takes its name.

Crimson clover is a winter annual. It succeeds best in the warm climate of the South. North of the Ohio River it is uncertain except in a few favored localities. It thrives best on sandy soil and is used chiefly to plow under to improve the soil.

White sweet clover. For years sweet clover, prominent along roadsides and on railroad embankments, was regarded as a weed. So great has been the prejudice against it that some farmers have sought through court action to prevent its introduction. However, "bee men" have long

recognized its value as bee pasture, and now sweet clover is recognized as having value as (1) a soil improver, (2) a hay and pasture plant, and (3) a preventer of soil erosion.

It is not one of the true clovers, but is closely related to and in many ways resembles them. It is widely distributed in Europe, and is thought to have been brought to us from there, probably in colonial times.

Sweet clover has a deep taproot from the crown of which are sent out many stems. These may attain a height of two or three feet the first year and perhaps five or more feet the second year, it being a biennial. The flowers are borne in racemes on the end of the stems.

The time and manner of seeding is the same as that for red clover. The seed coat is thick and often this is the cause of poor germination. An implement has recently

FIG. 167. *A field of red clover, timothy, and alsike*

been put on the market by the use of which it is possible to scratch or scarify the seed and thus improve the germination. Ten to fifteen pounds of scarified seed per acre is sufficient.

Sweet clover will not grow on acid soils. It requires an abundance of limestone.

Other sweet clovers. Yellow sweet clover is similar in appearance to the white except that it possesses fewer stems,

FIG. 168. *White sweet clover being cut with a mowing machine. The stems are too coarse to make hay of the finest quality*

matures two to three weeks earlier, and has yellow blossoms. It makes a finer quality of hay than the white.

Hubam sweet clover, an annual introduced in recent years, seems to have little to recommend it in preference to the biennial unless for some reason an annual crop is required. It is inferior to the biennial in the quality of hay produced and as a soil renovator. The root development is exceedingly small as compared with the biennial.

Lespedeza or Japan clover. Lespedeza is a hot-weather plant which finds its greatest usefulness in the southeastern part of the United States, where it is grown extensively for pasture and in a more limited way for hay. It is an annual with a creeping habit of growth and when ripe the seeds

shatter badly. Thus it reseeds itself readily in pastures. Its use in the North is restricted by cold weather. The northern limit of its adaptation is not far above the Ohio River. It is a native of Asia, and the first authentic record of its appearance in this country credits it to the state of Georgia in the year 1846.

Enemies of clover. *Dodder*, sometimes known as love vine, is a parasitic flowering plant with orange-yellow threadlike stems which twine round the stems of clover, taking nourishment from them and finally destroying the clover plant. If allowed to go unchecked, it will ruin entirely the infested part of the field. Such areas should be either dug up or burned over, and, above all, no clover seed should be saved from them, for it is with difficulty that clover and dodder seed can be distinguished. Dodder reproduces by seed, and when found in clover it means that the seed has been sown with the clover seed.

Anthracnose frequently causes great loss in clover. Sunken spots appear on the leafstalks, below the flower clusters, and on the stems near the ground. Ultimately these result in the death of the entire plant. This disease is quite prevalent in the region stretching from Delaware to Arkansas, particularly in Tennessee. No remedy is known, and hope, therefore, rests in the development of resistant varieties.

Mildew often develops on clover in the late summer and early fall, causing the leaves to become white. Its appearance is usually viewed with alarm, but it is not known to injure the plants. Neither is there any evidence that it affects the feeding value.

Alfalfa. *Origin.* Alfalfa has been grown in the Old World from the earliest times. Its extensive distribution in this country is comparatively recent, although its presence here is known to date back to colonial times, for it is recorded

that both Washington and Jefferson cultivated it on their farms. For some reason, however, the culture of it did not spread over the United States until it was reintroduced into California in 1851 from South America. It was brought to the latter country from the Old World.

Characteristics. If one were to examine closely an alfalfa plant, it would be found that in many respects it resembles sweet clover. It has a taproot, crown, and many branching stems proceeding from the crown. Alfalfa does not grow so tall as sweet clover. The purple flowers are borne in racemes on both stems and branches.

Fig. 169. *An alfalfa plant*

A desirable crop. For the proper development of farm animals "high protein" feeds are required. A good yield of alfalfa produces more protein per acre than any other crop. Dairymen regard alfalfa hay as about equal to wheat bran. Moreover, the growing of alfalfa enriches the soil. Therefore it is well to try to grow alfalfa wherever the soil conditions are favorable. The essential soil conditions will now be considered.

Culture. Alfalfa is at its best in the warm, dry climate of the Great Plains region, the largest acreage being in the states of Kansas and Nebraska. In the more humid regions of the East, where it must compete with clover and other moisture-loving plants such as timothy and Kentucky blue grass, its culture is more difficult and the yields are lighter. However, it can be grown there providing four conditions are met. These are: (1) good drainage, (2) fertile

land, (3) an abundant supply of limestone in the soil, and (4) inoculation.

If land is not well drained naturally, then it must be tile-drained. Alfalfa will not grow with wet feet. Though alfalfa will enrich land, it cannot be started successfully on poor soils. Fields too poor to grow good crops of corn will not produce profitable crops of alfalfa. Poor soil must be enriched by the use of manure or commercial fertilizers. Neither will alfalfa thrive on acid soils. This condition is most common in soils derived from sandstones and shales. The acid condition can be corrected by an application of limestone. Lack of inoculation often makes the difference between success and failure. Inoculation may be effected by the use of soil from an old alfalfa field or sweet clover patch, or by treating the seed with cultures which are prepared by commercial firms.

Alfalfa may be seeded (1) in the spring in wheat, oats, or barley as a nurse crop, (2) after some early crop such as field peas or potatoes, (3) in midsummer without a nurse crop, or (4) in corn at the time of last cultivation. If seeded alone, the seed bed should be firm, fine, moist, and free from weeds. From 10 to 12 pounds of seed per acre is sufficient. Undoubtedly many failures in the past are traceable to the use of seed imported from countries of warm climate.

Varieties. Alfalfa has not been differentiated into varieties to the same extent as have the cereal crops like corn, oats, and wheat. Only a few varieties have been developed and named, such as the Grimm, Cossack, Hardigan, and Orrenburg. Most of the alfalfa produced in the United States is the so-called common, and, as the name indicates, it is grown from the general run of seed produced in the central and western states, principally Kansas, Nebraska, South Dakota, Wyoming, Idaho, and Utah.

The Grimm, introduced into Minnesota in 1858 and an especially hardy variety, is grown chiefly in the northern states and Canada. The Cossack, introduced from Siberia, is another variety much prized for its hardiness. The Hardigan is said to produce seed more abundantly than other varieties in the humid regions of the East. The Orrenburg is recommended for pasture because the roots are said to branch freely and the habit of growth is more or less decumbent. Seed from some foreign countries such as Turkestan is not adapted for general use in the United States.

Harvesting. Probably the most palatable hay is obtained by cutting when about one-tenth of the plants have come into bloom. However, it has been shown that if the cutting is deferred to a little later stage, the food value of the hay

FIG. 170. *Curing alfalfa*

is increased, and the life of the plants, and hence the duration of the stand, is materially lengthened. Alfalfa is cured in substantially the same way as clover. About three cuttings may be obtained each year.

Enemies. Probably more failures in the growing of alfalfa have been due to weeds than to any other one cause. Such weeds as pigeon-grass and crab-grass are among the most troublesome. In the humid regions of the East many fields have been crowded out by Kentucky blue grass.

Leaf spot is the only disease of real importance that attacks alfalfa. Small black spots appear first on the leaves and later on the stems. Leaves badly infested turn yellow and finally fall off, resulting in considerable loss in the quality of the hay. The only practicable remedy is to mow the alfalfa as soon as the leaves begin to turn yellow. The disease does not kill the plants. The succeeding crop may be practically free from it.

Alfalfa is attacked and destroyed by dodder as clover is. In fact, dodder is a more serious problem with alfalfa than with clover, because the life of an alfalfa seeding is usually longer.

Soy beans. *Origin.* In China and Japan, where soy beans are native, they are used extensively, not only as food for man but in the manufacture of oil. For many years after they were first introduced into this country, they were grown as an ornament only. In the last two or three decades, however, they have attained much prominence and are now grown chiefly for stock feed and for the extraction of oil, the latter product being used as food for human consumption and in the manufacture of paint and varnishes.

Description. The soy bean, a summer annual, is an erect, hairy plant from one and one-half to four feet tall. It usually has a main stem which branches freely. The leaves are trifoliate. The blossoms are borne in clusters and are purplish or whitish in color. The pods, usually one to one and a half inches long, are hairy, yellowish or brownish in color, and bear from one to four — usually two or three — seeds. The seeds are smooth and may be yellow, green, brown, or black, with varying shades between.

Culture. The seed bed is prepared the same as for corn. The soy bean is a hot-weather plant and should not,

therefore, be seeded until reasonably warm weather is assured —about the first of June. If sown for the production of seed or silage, the seed should be sown in rows 28 to 30 inches apart, using 2 to 3 pecks of seed per acre. For hay of fine quality, the seed should be drilled solid, using 6 to 8 pecks of seed per acre. For silage, soy beans are sometimes planted in corn. Many corn planters are now equipped with an attachment for scattering soy bean seed. It is more common, however, to grow each crop in a separate field and mix the two as they go into the silo in the proportion of one part of soy beans to two parts of corn. The seed should be sown shallow. If it is more than one or two inches deep, the young plants may "break their necks" in trying to push through the crust. Either the seed or the soil should be inoculated.

FIG. 171. *A soy-bean plant after the leaves have fallen off. Note the branching habit of growth*

Varieties. There are many varieties varying widely in time of maturity, fineness of stems, yield, etc. The choice of variety, therefore, should be governed by the length of season available and the purpose for which the crop is to be grown. For hay, a fine-stemmed rather than a coarse-stemmed variety

FIG. 172. *Soy beans drilled in rows*

FIG. 173. *Cutting soy beans for seed with side-delivery attachment*

is preferable. For silage, a large-stemmed variety is not objectionable because the stems will be softened by the juices in the silo.

Harvesting. For seed, soy beans should be cut when the pods have become brown or black and many of the leaves

have fallen off. For hay or silage, they are ready to cut when the pods are well formed but before the leaves begin to fall. No special machinery is required. However, in harvesting seed a side-delivery attachment is advisable, as the use of it prevents the loss of seed by trampling. The hay is cured in about the same way as clover. It is well to bunch the beans as soon as the plants are nicely wilted in order to prevent the loss of leaves, which are the most nutritious part of the hay. For silage, the beans may be cut with a grain binder and bound into bundles like wheat. The straw left from threshing is eaten by all kinds of live stock, especially sheep.

The cowpea. Another summer annual, a native of the Orient and rather generally distributed throughout the warmer regions of the world, is the cowpea. This plant is thought to have been introduced into this country early in the eighteenth century. In the South it is extensively grown and is held in high esteem as a crop for forage, green manuring, and food for man. However, with few exceptions, it cannot compete successfully with the soy bean north of the Ohio River.

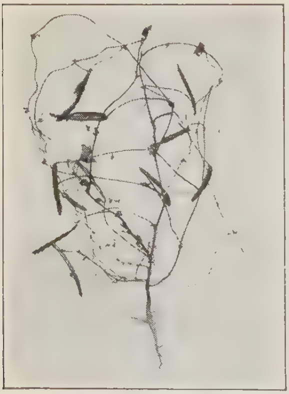


FIG. 174. *Cowpea plant*

Vetch. Vetch is a legume of minor importance in the northern states. It is grown extensively in the West, and in a limited way in the South. It is a winter annual, with fibrous roots and long, trailing, viny stems too weak to support themselves. The midrib of the compound leaves terminates in a tendril with the use of which it is able to climb. The bluish-purple flowers are borne in racemes which develop from the axils of the leaves.

Vetch is used chiefly (1) as a cover crop, particularly in orchards, (2) for green manuring, (3) for soiling, and (4) for hay or pasture. It is frequently seeded with some cereal, usually rye, about 20 pounds of seed per acre and about one bushel of rye being used. The mixture makes good late fall and early spring pasture, or, if allowed to continue to grow, it makes good succulent feed for use in early summer.


FIG. 175. *Hairy vetch, roots with nodules*

Field peas. In general appearance the field pea resembles closely the common garden pea. However, it is coarser and grows much taller. The field pea is often confused with the cowpea, but the two are altogether unlike in habit of growth.


FIG. 176. *A single plant of the field pea showing nodules on the roots*

Field peas are grown chiefly for hay, for soiling, or for plowing down to improve the soil. When sown for hay or for soiling, the peas are usually seeded with oats, the latter serving as a support for the peas. The two should be sown as early as the ground can be worked, using about 1½ bushels per acre of each kind of seed. The crop is ready to cut for hay when the pods are well formed but not filled. For continuous feeding through the summer, dairymen often make several seedings of field peas at intervals of

ten days or two weeks, putting in just enough seed each time to last until the next seeding is large enough to use.

FIG. 177. *Field peas and oats growing together*

NONLEGUMES OR GRASSES

Grasses are characterized by a fibrous root system; round, jointed, usually hollow stems; long, narrow, and parallel-veined leaves; and inconspicuous flowers, usually borne in spikelets which may be arranged either in spikes or panicles. They may be annuals or perennials.

Timothy. There are many forms of grasses, and all of them are useful under certain conditions, but none of them is grown so universally as timothy. This grass is said to have been introduced from England in 1720 by Timothy Hanson. Each root system sends up several leafy stems at the end of which is borne a spike or head.

Although timothy is frequently included in pasture mixtures, it is distinctly a grass for meadows, and as such it stands in the first rank. On land too acid for clover to thrive, timothy is the chief hay crop. It is generally seeded with wheat, either in the fall or spring, using 12 to 15 pounds

of seed per acre. For hay of best quality—greatest quantity of digestible nutrients and high palatability—timothy should be cut when the grass is in full bloom. However, from the standpoint of the permanence of stand it is best to defer cutting until the hay is ripe, or at least until the seed has reached the dough stage. Pasturing early in the spring or too soon after cutting is injurious.

FIG. 178. *A timothy head in bloom*

Other perennial grasses. In a more restricted way other grasses of minor importance are sometimes grown and cut for hay. Among these are *red top*, *orchard grass*, the *fescues*, *tall oat grass*, *brome grass*, and *rye grass*.

Annual grasses. Usually as emergency crops several annual grasses are commonly grown, such as millet, sorghum, and Sudan grass.

Millet. The term millet is applied to a great variety of cereal and forage grasses. Botanically they differ widely, but all of them are alike in that they are (1) annuals, (2) hot-weather plants, and (3) utilized primarily as hay and forage. Farmers do not regard them as staple crops, but rather as "catch" or emergency crops. In case of partial or complete failure of the corn crop, the hay crop, or any spring-seeded crop, there is still a chance to grow a crop of millet.

There are three general classes of millet: (1) foxtail, (2) broom corn, and (3) barnyard. The foxtail

group is the most commonly grown and it is distinguished from the others by reason of the fact that the shape of the head is a single spike.

Millet should not be seeded until all danger of frost is past. About 3 pecks per acre is the right quantity of seed to insure hay of fine quality. It is ready to cut for hay as soon as the heads begin to appear, and the quality of the hay begins to deteriorate rapidly if the crop is allowed to stand long after the blooming stage. Millet hay is cured in practically the same way as timothy.

Sorghum. Next to corn the sorghums are perhaps the most important annual grasses. In general appearance sorghum resembles corn. Three types are generally recognized: (1) saccharine, (2) nonsaccharine, and (3) broom corn. The first group was formerly grown largely for syrup, but now it is utilized largely as forage. Agriculturally, the term "sorghum" is frequently restricted to this division alone. The nonsaccharine sorghums are grown chiefly in semiarid regions and for the production of grain. In humid climates like that of Ohio they are of minor importance as compared with corn. Broom corn is of little value for forage. It is grown chiefly for brush with which to make brooms.

Sorghum is sensitive to frosts and should not, therefore, be seeded until warm weather is assured. It may be drilled solid, using about one bushel of seed per acre, or it may be drilled in rows 36 to 42 inches apart, using 8 to 15 pounds of seed per acre. Solid drilling is best for hay, but the rows are satisfactory for soiling or silage.

For hay of best quality, sorghum should be cut shortly after blooming. For soiling, it can be cut any time after it is large enough to handle, but preferably from the time of blooming to near maturity. For silage, it is best cut when the seed is in the dough stage. Sorghum makes good

pasturage under most conditions, but it sometimes causes poisoning if pastured following a drouth or a frost. Sorghum is more resistant than corn to drouth, and can therefore be used to advantage in regions of moderate rainfall. Amber and orange are the most common varieties, and in northern

FIG. 179. *A head of millet*

FIG. 180. *A head of Sudan grass*

regions the amber is preferable because it ripens about three weeks earlier than the orange.

Sudan grass. A recent and promising plant introduced into Texas in 1909 is Sudan grass. It is a rather coarse, broad-leaved, rank-growing annual, closely related to Johnson grass. It is probably most useful in semiarid regions where, for lack of water, plants such as alfalfa, clover, and timothy do not thrive well. The culture of it is increasing in the Southwest.

Like millet or sorghum, Sudan grass should not be seeded until warm weather is assured. For hay of finest

quality it should be drilled solid, using 15 to 25 pounds of seed per acre. The most palatable hay is secured by cutting the crop when it is in the bloom stage. The hay is cut with a mower and cured the same as timothy. It may yield as high as 4 tons per acre. At best the forage made from Sudan grass is somewhat coarser than that made from the millets.

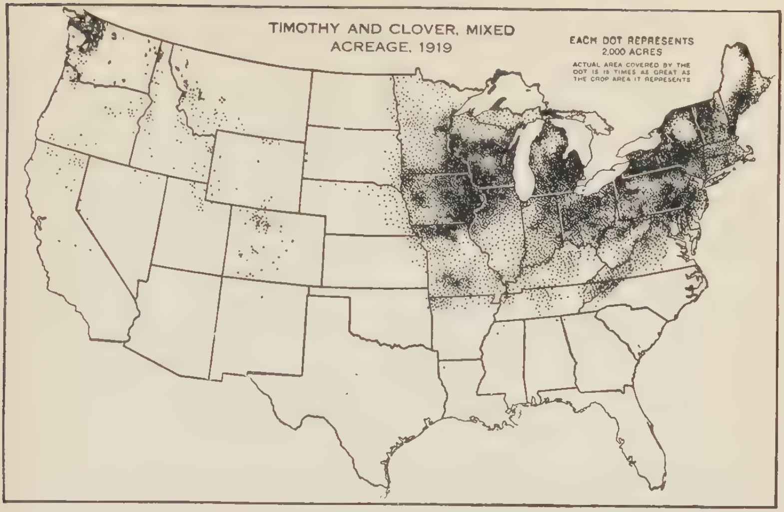
Small-grain crops for hay. In case of emergency the small grains, such as oats, wheat, and rye, can be utilized as forage. Of the three, oats is most useful for this purpose. If cut in the milk or dough stage, oats make a nutritious and palatable hay. Oats can be used also to thicken a thin or old meadow. As soon as the ground is in proper condition to work, the oats may be disk-drilled in the thin stand of clover or timothy, using about 8 pecks of seed per acre.

Mixed hay. Often timothy is seeded with clover and the two are harvested as mixed hay. In the northeastern part of the United States mixed hay is one of the most common forage crops. The states in which the mixed hay is produced are shown in Figure 181.

Red clover is most commonly mixed with timothy, but on soils of low lime content it is better to use alsike clover, or at least to mix a little alsike with the timothy and red clover. A suitable mixture for each acre of ground is:

Red clover	7 pounds
Alsike clover	3 pounds
Timothy	6 pounds

Such a mixture, sown in the spring in wheat or in oats as a nurse crop, will produce a crop of hay the following year. If the meadow is allowed to stand more than one season, the larger part of the forage in the second and subsequent years will be timothy. When pure clover is desired, timothy seed is, of course, omitted from the mixture.



Courtesy United States Department of Agriculture, *Yearbook*, 1921

FIG. 181. *States in which mixed hay is produced*

QUESTIONS

1. What is forage?
2. Name four kinds of forage.
3. Name two groups of forage plants.
4. Name five different kinds of clover.
5. Name three kinds of "sweet" clover.
6. Discuss the value of alfalfa.
7. Name four requirements for the growing of alfalfa.
8. Which are the more useful, soy beans or cowpeas?
9. Name three purposes for which soy beans are grown.
10. Give four uses for vetch.
11. Give three uses for field peas.
12. Name a good mixture of seeds for "mixed hay."
13. What is the most important grass for hay?
14. Name six other perennial grasses sometimes grown for hay.
15. Name three annual grasses.
16. Name three characteristics of millet.
17. Name three kinds of sorghum.
18. Where is Sudan grass most useful?
19. Which is the most useful small-grain crop for hay?

PROJECT LESSONS

Exercise I

Object. To determine the germination of seeds of forage plants.

Materials. Samples of seed and a seed tester which can be improvised from the use of two plates and pieces of blotting paper or cotton flannel.

Procedure. A few pupils may write to several seed companies asking for quotations and for small samples of such seeds as red and alsike clover, sweet clover, alfalfa, timothy, etc. Upon receipt of the seeds, those coming from each company should be germinated separately. This can be done by placing one hundred seeds on moistened blotting paper between plates kept in a warm place five or six days. The project can be carried out by one pupil or by several working in a group.

Conclusions. Calculate the percentage of seeds that sprouted. Tabulate the results and determine which firm is offering the best price on seeds, considering their germination. This will provide helpful information for the farmers of the community.

Exercise II

Object. To study nodules on different legumes.

Materials. Individual plants of such legumes as clover, alfalfa, soy beans, or vetch, and a pail of water.

Procedure. Dig up plant, place in pail of water, and carefully wash off the dirt. Note the size, shape, and number of nodules.

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CHAPTER XXIV

SMALL GRAINS

The cereal crops exclusive of corn and the grain sorghums are usually spoken of collectively as the small grains. The leading small grains grown in the northern states are oats, wheat, barley, and rye. All of these except wheat will be considered in this chapter. The importance of wheat is so great that it will be taken up separately.

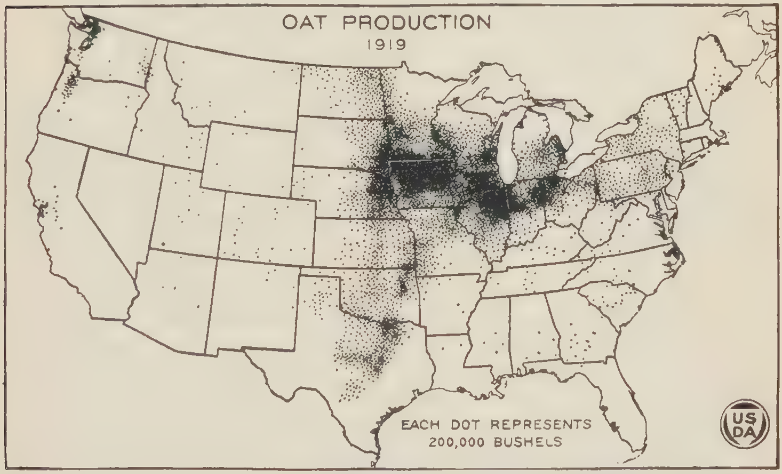
OATS

Origin. The early history of oats is uncertain. Apparently they played a much less important part than did wheat or rye in the early civilizations of the world. No mention is made of them in the literature of the Greeks and Egyptians. The evidence indicates that they were derived from wild forms, and it is thought that the development took place in eastern Europe or western Asia.

Production and distribution. For the period 1920–1924 inclusive, the world's oat crop exceeded 3,500,000,000 bushels. Fifty per cent of it was produced in North America, 40 per cent in Europe, and the remaining 10 per cent chiefly in South America, Australia, Asia, and Africa. Of the 1,800,000,000 bushels produced in North America, 73 per cent was produced in the United States, and nearly three-fourths of the crop grown in the United States was harvested in ten states: Iowa, Minnesota, Illinois, Wisconsin, South Dakota, Nebraska, North Dakota, Indiana, Ohio, and Michigan, in the order named. The distribution of oat culture in the United States is shown in Figure 182. Oats are best adapted to a cool climate. In regions of high temperature they are not usually very successful

unless there is an abundance of rainfall. On the southern border of the oat belt, the yield and the quality of the grain are inferior to those grown in the North. In regions where the winters are mild, as, for example, the southern part of the United States, oats are sown in the fall, and are then known as winter oats.

The oat plant. A good way to become well acquainted with the oat plant is to go into a field of ripening oats and



Courtesy United States Department of Agriculture, *Yearbook*, 1922

FIG. 182. *Oat production map*

examine carefully a few individual plants. If this were done it would be found that the stalk of oats, unlike that of a corn plant, is hollow. It does not always appear to be hollow because sometimes there is present in it small quantities of pith. In fact, the stalk is not altogether hollow, because at irregular intervals there are nodes or joints. These are solid, and they help to retain the cylindrical form and strength of the stalk. At the base, where most strength is needed, the nodes are closest together. Being hollow between nodes, the stalk is able to support

the weight of the head and at the same time to bend as the head sways in the breeze. A hollow stalk is always stronger than a solid one containing the same quantity of material.

Oats shoot up rapidly because elongation or growth of the stalk takes place not only at the top but simultaneously in each of the sections between the nodes. At the same time at which the stalk is lengthening, the head or panicle is developing. The time at which the head first appears is known as the heading stage. Soon after the head emerges the formation of the grain begins. Even before the kernels have completely formed, the lower leaves begin to die. About a month after the appearance of the head the whole plant becomes yellow, and it is then ready to harvest.

The seed, in germinating, first sends out a temporary root system which may consist of five or more roots. Later, permanent roots appear in whorls at nodes about an inch below the surface of the ground. In their development the permanent roots curve outward and then grow downward to a depth of three or four feet. They branch freely, and thus form a network of fibrous roots near the surface.

From a single oat seed many stalks may come up, in which case the plant is said to "stool" or "tiller." Ordinarily, however, one or two stalks only come up, though under favorable conditions from twenty to fifty or even more may develop. This is a matter of considerable importance, for it tends to make a good "stand" of plants.

Uses and value of oats. Unlike corn or wheat, oats are seldom grown as a cash crop. At the same time they rank third in importance among the cereal crops grown in the United States. The extensive culture of oats is due chiefly to (1) the economy of labor in raising the crop, (2) their usefulness in rotations as a nurse crop in seeding clover and grasses, and (3) their value as food for human beings and as feed for live stock. Without oats there could be no

oatmeal porridge for breakfast. Moreover, oats are held in high esteem as a feed for dairy cows, sheep, especially lambs, and for horses. No grain seems quite equal to oats in keeping horses in high spirits. Oat straw is more nutritious than is that of any of the other cereals.

The annual value of the oats produced in the United States is estimated at $500,000,000 — about one-fourth the value of the corn crop and one-half that of the wheat crop.

FIG. 183. *Plowing for oats*

Growing the crop. *Soil and fertilizers.* Oats do well on any kind of soil, providing it does not dry out too readily. Oats require more water than the other small grains, but, nevertheless, the soil should be well drained.

Oats usually are seeded after some cultivated crop such as corn, sugar beets, or potatoes. Ordinarily these crops are heavily fertilized, and enough fertility remains in the soil to meet the needs of the oat crop. On very thin land, however, a light application of acid phosphate is profitable.

Seed bed. Ordinarily the seed bed for oats receives less preparation than does that for any other cereal crop. The reason for this slight preparation is that the crop is seeded early in the spring at a time when the soil and weather conditions are often unfavorable for more careful preparation.

In some sections the seed is broadcast on corn-stubble ground in late February or March, without any previous

Fig. 184. *Preparing the seed bed*

Fig. 185. *The harrow breaks the clods*

preparation, depending on subsequent freezing and thawing to cover the seeds. In some cases the seed is sown on disked ground. This method gives good results providing the land is comparatively free from weeds. However, fields that are inclined to be weedy should be plowed. If the nature of the soil is such that it will not puddle or wash,

the plowing may well be done in the fall, because that saves much valuable time in the spring when the rush of other work is pressing. Fall-plowed land should be disked as soon as it is dry enough to work in the spring. Spring-plowed land should be rolled as soon as possible, and then thoroughly packed with a cultipacker.

Kinds of oats. There are many kinds of cultivated oats, but all of them are grouped into two classes — spreading or open-panicle, and side or horse-mane oats. This distinction is based on the shape of the head, the branches spreading in all directions in the open-panicle and in one direction only in the side oats. The color of the grain also varies. It may be white, yellow, black, red, or gray. White, however, is the color that is most commonly seen.

FIG. 186. *Two types of oats, open-panicle and side oats*

The variety. Much of the success of an oat crop depends on the choice of a good variety. Different varieties of oats grown under uniform conditions may vary in yield 15 or more bushels per acre. High yield, resistance to disease, and stiffness of straw are among the more important characteristics of desirable varieties. Through head selection and other methods, new and improved varieties are continually being developed and placed on the market. These improvements are made possible by reason of the fact that no two oat plants are exactly alike. They differ from each other the same as do individual people. We do not

FIG. 187. *Stiff- and weak-strawed varieties of oats*

FIG. 188. *Left—no treatment; 38 bushels per acre; right—80 pounds acid phosphate: 49 bushels per acre*

notice the difference between individual oat plants the same as we do between individuals of the human family simply because we are not so well acquainted with the habits of oat plants. Some varieties are high yielders, others are low yielders; some varieties have stiff straw, others have weak straw; some are resistant to disease, others are not.

FIG. 189. *Drilling oats*

By selecting a large number of heads and planting the seed from each in a separate row, persons who have the necessary time and patience are able, through many years of work, to find superior strains. After such strains have been carefully tested and have proved their worth, they are named and placed on the market. Most work of this kind is carried on by agricultural experiment stations. In selecting oats to plant, it is well to consult your county agricultural agent regarding the latest and best varieties.

Sowing the seed. Oats thrive best in cool weather, and they should therefore be sown as early in the spring as the land can be put into shape for the planting. In the northern states most of the oats are sown some time in the month of April. About 10 pecks per acre makes a good seeding. Formerly it was customary to broadcast the seed, but experiments have shown that better yields may be obtained by drilling. The seed should be thoroughly cleaned in a good fanning mill in order to remove broken and shrunken grains and all foreign substances, such as weed seeds, broken straw, chaff, and other material.

Harvesting and threshing. Oats should be cut when the grain is in the dough stage and when some of the leaves are still green. If oats are allowed to become too ripe, there will be loss in handling. The bundles should be promptly shocked, ordinarily ten in a round bunch and two caps on top. If the oats are somewhat green, they are best set out in narrow shocks, two by two, without caps. If a threshing machine is available, oats may be threshed directly from the field. However, it is thought that a better quality of grain is secured if threshing is deferred until the oats have had a chance to go through a sweat in the mow or in a stack.

Enemies. Oats are attacked by several diseases, but the losses are not equally severe from year to year. They are more or less periodic in their occurrence. The diseases which most frequently cause appreciable loss are the smuts and rusts. Of these two, the smuts are the more destructive, the loss sometimes amounting to 10 or 20 per cent of the crop. These may be prevented by treating the seed. Several methods are available, but sprinkling with formalin is the recognized standard. The oats are placed in a pile on a tight floor or canvas and sprinkled with a solution of 1 pint of 40 per cent formaldehyde to 40 gallons of water, an ordinary hand sprinkler being used. The grain is shoveled while being sprinkled, and both processes are continued until every kernel is moistened. After treatment, the grain is heaped in a pile and allowed to remain there two or three hours, after which it is spread to dry. All of the tools and bags used in handling the grain after treatment should be sprinkled with the formalin solution. If possible, it is best to drill the grain as soon as it is dry. Under certain conditions injury to the germination of the seed may result from the treatment. Modifications of the formalin method have been devised. Dust treatments also are coming into use.

Oats are also attacked by various rusts. The most destructive of these is one which attacks the stalk. It is known as the black stem rust. As a rule this rust is not

FIG. 190. *Smuts of oats: covered smut left, loose smut right. Note striations on leaves at right*

very injurious, although in occasional years it causes appreciable loss, especially in the northern states. Leaf rust is quite common, but usually it does not cause so much injury as stem rust.

In certain sections, particularly in some of the eastern and central states, considerable damage to oats may result from bacterial blight. In the advanced stage the leaves take on a reddish color and they may partially collapse. Rainy warm weather favors its development.

RYE

Importance and distribution. About four-fifths of the world's crop of rye is produced in Europe. In other parts of the world it is a crop of minor importance. In the United States about seventy million bushels are produced annually. For each bushel of rye grown in this country, there are produced about 12 bushels of wheat and about 19 bushels of oats. The leading rye-producing states are North and South Dakota, Minnesota, Wisconsin, Michigan, and Indiana. The general distribution of the crop as grown in the United States in 1919 is shown in Figure 192.

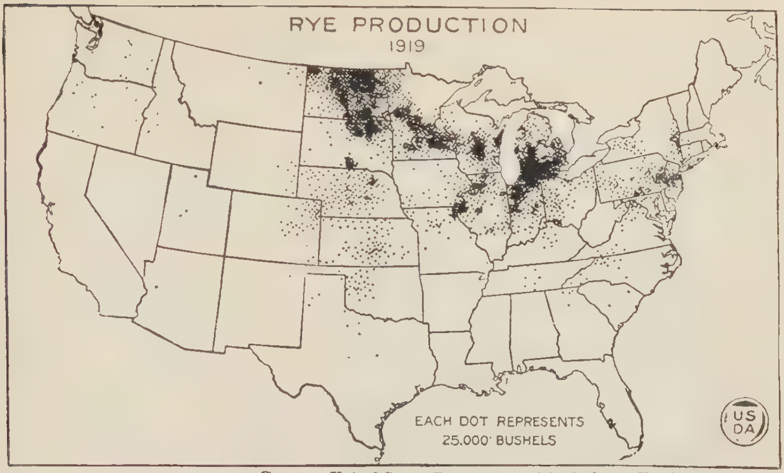
FIG. 191. *Head of rye in bloom*

Uses. Rye bread is a common article of diet in Europe, and it is used to some extent in the United States. Rye makes good feed for live stock, particularly hogs. The straw is used for packing nursery trees, stuffing horse collars, making mats, and for many other purposes.

Growing and harvesting the crop. The culture of rye is practically the same as is that of wheat. However, it will grow better than wheat on poor soil, especially light sandy soil. Rye is more hardy than wheat and can be seeded later in the fall, even in November, with fair assurance of success. The usual seeding is at the rate of from 6 to 8 pecks per acre.

The harvest comes about a week earlier than does that of wheat. In shocking, the bunches are usually left without caps.

Ergot is the most serious of the diseases which afflict rye. It is a fungous disease which causes the development of



Courtesy United States Department of Agriculture, *Yearbook*, 1922

FIG. 192. *Where rye is grown*

FIG. 193. *Plowing under a crop of rye*

purplish-black bodies in place of the seed, and at maturity they are several times longer than are the mature seeds. Ergot bodies lose their vitality with age. Therefore, unless rye seed is more than one year old, the ergot should be

removed. This can be done by pouring the seed into a 20 per cent solution of common salt. The ergot bodies float and may be skimmed off, while the rye kernels are left.

FIG. 194. *Rye and hairy vetch*

BARLEY

Origin and adaptation. Barley is thought to have been developed in Western Asia at an unknown but ancient date. Probably its cultivation dates back as far as that of wheat, and many hundreds of years before that of oats or rye. As a world crop it is much less important than either oats or wheat. About 75 per cent of the world's crop is produced in Europe. However, its distribution is widespread. This is due to its ability to develop and mature at high altitudes. About 70 per cent of the barley grown in the United States is produced in six states: California, Minnesota, South Dakota, North Dakota, Kansas, and Wisconsin, in the order named.

As a food, barley is used chiefly for thickening soup. In times of great stress, as in the World War, it is sometimes used as a substitute for wheat in baking. About 50 per cent of the barley grown in the United States is fed as grain to live stock. Approximately 20 per cent is used in brewing and distilling. Brewers' grain is a valuable by-product highly esteemed as a feed for dairy cows.

The culture of the crop. Barley thrives under a wide range of soil and climatic conditions, but it grows best on fertile, well-drained clay loams. It is usually seeded after some cultivated crop such as corn, rather than after a root crop such as sugar beets or turnips. The seed bed is prepared the same as is that for oats. The seed should be sown early in the spring, and at the rate of 6 to 12 pecks per acre. When the grain reaches the dough stage it is ready to cut. It should not be allowed to become overripe.

FIG. 195. *Heads of two- and four-rowed barley*

In the South, barley is usually sown in the fall, but not many varieties are able to go through the winters in the northern states.

Barleys are often classified according to the arrangement of the kernels on the head as six-rowed, four-rowed, or two-rowed. Most varieties have beards, but farmers find these objectionable, and for that reason a few beardless varieties have been developed in recent years.

BUCKWHEAT

Buckwheat is not a true cereal. On the contrary, it is closely related to such plants as smartweed and sour dock. The name is interesting. It comes from the German term

Buckweizen, which means "beech-wheat," and the term "beech-wheat" is suggested because the shape of the buckwheat seed resembles that of the beechnut.

Origin and importance. Buckwheat is thought to have originated in Asia. It is a crop of minor importance even in the states where it is most extensively grown — New York, Pennsylvania, West Virginia, Michigan, and Minnesota. The annual production in the United States amounts to less than one-fiftieth of the production of wheat.

FIG. 196. *A single buckwheat plant, early Japanese variety*

Uses. So palatable are buckwheat cakes and maple syrup that practically all of the crop is used to make buckwheat flour. The milling by-products — bran and middlings — are fed principally to hogs and cattle. A small portion of the grain is utilized as poultry feed. It is also an excellent honey plant, and it is used to some extent for green manuring and as a cover crop.

Culture. While buckwheat is adapted to a variety of soils, it will probably do better on poor soils than will almost any other crop. It is commonly seeded after the failure of some other crop, and the preparation of the seed bed, therefore, usually receives but little attention.

Buckwheat is a short-season crop, two to two and a half months being required to grow it. Ordinarily it is seeded about June 20 to July 10. Late seeding is necessary in order to avoid frosts. Furthermore, if the seed is sown

too early the weather may be hot and dry when the bulk of the blossoms appear, and this often causes blasting and loss of seed. From 2 to 5 pecks per acre is regarded as a good seeding. The seed may be broadcast or drilled. On a well-prepared seed bed it is usually drilled. The Japanese, Silver Hull, and Common Gray are the varieties most generally grown.

Harvesting. A head of buckwheat may contain blossoms, mature seeds, and all gradations of maturity between. The crop is best cut when the heads contain the largest percentage of mature seeds. Sometimes it is cut when the first blossoms mature seeds. It should always be cut before the plants are injured by frost.

Buckwheat is sometimes cut with a binder, and the bundles are set up in long narrow shocks without caps. If cut with a hand cradle, the loose grain is allowed to lie in the swath a few days, after which it is shocked, but with no caps. Buckwheat is usually hauled directly from the field and threshed in an ordinary threshing machine.

QUESTIONS

1. What is meant by "small grains"?
2. Name the leading oat-producing states.
3. Give three reasons for growing oats.
4. Discuss the culture of oats as to preparation of seed bed, time of seeding, rate of seeding, harvesting.
5. What are the leading oat varieties grown in your community?
6. In what states is most of the barley grown in this country?
7. For what purpose is barley grown?
8. Is buckwheat grown in your community?
9. For what is buckwheat used chiefly?
10. Discuss briefly the culture and harvesting of buckwheat.

PROJECT LESSONS

Exercise I

Object. To find out the common method of growing oats in your community.

Materials. Pencil and paper.

Procedure. By inquiring among farmers who grow oats, find out the following:

a. Number of acres sown to oats on each farm
b. Is the ground disked or plowed?
c. Kind of fertilizer used; amount applied per acre
d. Name of variety sown
e. Time of seeding
f. Amount of seed used per acre
g. Yield per acre

Conclusion. Write a brief report summarizing the information you have obtained.

Exercise II

Object. To determine the viability of the seed.

Materials. Small box (16 inches long, 12 inches wide, and 2 inches deep), moist soil, and 100 kernels of oats.

Procedure. Fill the box with fine moist soil. Mark off four rows and plant 25 seeds in each row, or 100 altogether. Place box where the temperature will be about 60° F. Keep the soil moist. In about ten days count the number of plants that have come up. The number will be the percentage of germination of your sample. If a farmer normally sows 10 pecks of seed per acre, assuming that all of it will grow, then how many pecks should he sow providing the germination is 85 per cent? 60 per cent?

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CHAPTER XXV

GARDENING

Why a garden? Not many years ago a great national organization was developed to promote "war gardens." It was found at that time that all the food that could be grown by farmers was needed for the use of the armies. As a matter of national economy and thrift, people were urged to prepare gardens. Thousands of boys and girls worked at the preparation of some kind of garden. The reason was that by raising a garden the cost of living was lowered, and the family had food which it would otherwise have to do without. Fresh, wholesome vegetables should be a part of the diet of everyone, and if these are grown at home much worry and time are saved in planning and preparing the meals. The home garden offers boys and girls an opportunity to do some work of value. Gardening induces physical exercise and out-of-door recreation, as well as profit and pleasure. While working with plants, one learns many things about them which develop an interest in living things. By turning small, undesirable waste places into gardens which will yield food and add beauty to our surroundings, we become better citizens. A true gardener has a certain amount of pleasure in producing things.

Some desirable features of a garden. A garden plan, drawn upon cardboard or paper, has been suggested as the best way to start. The aim should be to draw an outline of the garden, indicating the rows of onions, radishes, cabbages, and other vegetables. The reason for such a plan is to help in planning how to proportion the garden to have a supply of good vegetables over a long period, and to provide for rotations. The garden should not be too far

from the house. The soil can hardly be too fertile. Sunshine is important for most garden plants, but many plants require shade. The size of the garden naturally varies with the number of people using the products. It has been generally noted that most gardens are too large. Under

FIG. 197. *Some common garden tools: dibber, tape measure, measuring line, hand weeder, garden fork, spade, rake, hoe, trowel*

favorable conditions, the ordinary family can produce enough vegetables from a plot fifty by seventy-five feet. This would not include spaces for potatoes, corn, and melons, these being more frequently grown as field or truck crops. The aim should be to have a garden small enough so that it may be well cultivated. A weedy garden is undesirable.

Fertilizing a garden. Applications of well-decayed manure have been the best agencies for making garden soils fertile. The quantity is seldom too large if the manure is well mixed into the soil during the winter. As much as six inches of manure has been worked into the soil, especially clay,

without injury to the plants. Ashes and lime improve the mineral content of the soil. Commercial fertilizers are a valuable source of fertility. The so-called complete fertilizers are the most effective, and should be applied over the entire surface of the ground instead of in the row. After the crop has been removed, green manure or cover crops may be grown to be plowed under as fertilizer for the next year. Rye, soy beans, and cowpeas are the best kinds of cover crops.

Preparing the soil. Most farmers plow the garden as soon as the ground settles in the spring. It is important that the soil be dry. Harrowing and rolling condition the soil quickly. If a large roller cannot be used, it might be well to use a lawn roller. A garden rake is perhaps the best tool for conditioning the surface for planting.

Varieties of vegetables to be selected. The likes and dislikes of the entire family should be considered in choosing garden plants. It would be of little use to plant several rows of corn in the garden if only one member of the family ate corn. On the other hand, if all members of the family like strawberries, the area devoted to this crop should be larger. In choosing vegetables, those maturing at different times and yielding most abundantly should be considered. Every garden should contain early, medium, and late varieties. The slogan should be, "Have something for the table every day in the year." Resistance to disease and insects is a desirable feature of good garden varieties.

Preparations for planting. The early bird raises the most garden, avoiding the worms, and some preparation for an early crop is advisable. As early as the first of March, tomatoes and lettuce may be started in small beds for transplanting. After the plants have grown to a height of two or three inches, they may be transplanted to paper

containers. By the first or the middle of May large plants are ready to be placed in the garden. This method is especially desirable for producing head lettuce. Hotbeds and coldframes may be used for the same purpose. Cabbage and cauliflower are often handled in this way. Peas, onions, and radishes may be planted outdoors as soon as the ground can be cultivated.

FIG. 198. *Seedlings ready for transplanting*

FIG. 199. *Tomatoes and lettuce may be started early in the spring and transplanted when it becomes warm*

Cultivating. Hoeing is still the standard method of cultivating the garden, just as spading is the popular method of turning the soil. For the larger gardens, there are hand cultivators to take the place of hoes, and even tractor cultivators. The main object should be to free the garden from weeds and to condition the soil for the best growth of the plants. The most common tendency is to plant vegetables in straight rows, but some good gardeners insist upon having everything in beds.

Preparation of food for winter months. We should not be contented with the use of vegetables during the growing season, but should put away the surplus for winter use. Such vegetables as tomatoes, beans, okra, and corn may be canned. The work is done from time to time when the vegetables are ready. Cabbage and cucumbers are preserved in the form of kraut and pickles. Such crops as turnips, carrots, and parsnips may be banked in cool shady places or in a root cellar. The onions may be thoroughly cured in the field and stored in a dry place where they will not freeze. Irish potatoes are best stored in a dark cellar. Celery is usually covered with straw or paper in a trench.

School gardening. In communities where the interests are decidedly agricultural, and especially where the farmers do truck gardening on a commercial basis, there is need for a school garden. It is of first importance to learn the methods of growing the common vegetables for the home. The introduction of different kinds of plants adds much more interest to the school garden. The applications of soil improvement and of better agricultural methods is of much importance. The profits from the sale of garden products may be a means of creating an interest in the work of the school. A clean, well-cultivated garden is an attractive part of the school ground.

What can be learned from school gardens? There are so many things in connection with the cultivation of the soil, the growth of seeds, and the development of a crop that we can hardly begin to enumerate the benefits. Many students do not have an opportunity to have a garden at home. The school garden is a splendid place to learn productive teamwork. While we admit that "one boy is a boy, two boys are a nalf a boy, and three boys are no boy at all," proper supervision will overcome many of the difficulties. The actual methods of farming may be taught better with a garden as a laboratory.

QUESTIONS

1. Give six reasons why every home needs a garden.
2. Where should a garden be located?
3. Give the size of a garden best suited for the home.
4. What kinds of fertilizers are used for the garden?
5. Name ten kinds of garden plants.
6. What tools are used in gardening?
7. How does the storage of turnips in a pit covered with straw and earth prevent their freezing?
8. How should a school garden differ from a home garden?
9. Why are vegetables used as food?
10. What vegetables do you like best?

PROJECT LESSON

Exercise I

Obtain a plot of ground and make plans for a school garden. Arrange for a portion of the garden as a permanent experiment plot. This should include various flowers and new crops. Request the Bureau of Plant Industry, Washington, D. C., to send you samples of seeds and roots from which to grow plants. Each student should be assigned some definite problem to be solved with his plot.

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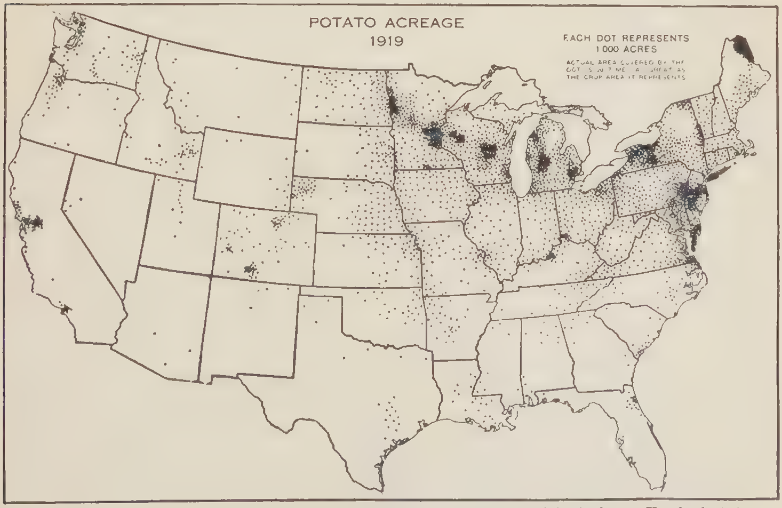
CHAPTER XXVI

POTATOES AND ROOT CROPS

THE POTATO

Origin of the potato. The early history of the potato is not definitely known, for it is not found growing wild. The original home was probably in the Andean highlands of South America. It is thought to have been introduced into Europe soon after the conquest of the Andean region, and after spreading through Spain, Italy, Belgium, and England it finally reached Ireland, where it was first grown in a commercial way as a food plant. For years it seems to have been regarded as a curiosity, for its intensive culture in Ireland did not begin until late in the eighteenth century. By the Irish settlers it was brought to New



Courtesy United States Department of Agriculture, *Yearbook*, 1921

FIG. 200. *The dots indicate the localities of greatest potato production*

Hampshire in 1719, nearly two hundred years after it left South America.

Distribution and importance. The potato is a cold-weather plant. In the region of its origin the temperature the year round is near 60° F., and today the potato is the most important field crop throughout the belt which has a temperature during the growing season near 60° F.

The annual potato crop of the world approximates five billion bushels. Over 90 per cent of it is produced in Europe and about 50 per cent in two countries—Germany and Russia. Over four hundred million bushels, or less than 10 per cent of the world's crop, is produced in the United States. A few potatoes are grown in all the states, but the greatest production is in New York, Minnesota, Wisconsin, Maine, Michigan, and Pennsylvania.

The world's crop is probably exceeded in value by one crop only, and that is rice. The value of the European crop almost equals that of the world's wheat crop.

The potato plant. The roots of the potato plant are comparatively small, all of them being of a fibrous nature. It is natural to think of the tubers as a part of the root system, but they are not. They are enlarged underground stems in which are stored large quantities of starch. The smooth, usually solid, quadrangular-shaped stems may attain a height of four or more feet. On the stems are borne compound leaves, and, between these, pairs of small leaflets develop. The flowers are borne in clusters at the end of the stems. They are white, purple, or lilac in color. The seed balls, usually less than an inch in diameter, are green or yellowish in color. Modern varieties seldom bear seed balls. If they do, the seed in the seed balls is rarely planted because it is likely to produce many inferior types of potatoes. On the contrary, plants grown from tubers tend to produce potatoes like the parent, and for that

reason they are always planted. Such tubers are known as "seed potatoes" or "seed."

Growing the crop. *The soil.* By many authorities it is stated that potatoes are grown chiefly on sandy soils, and from that fact the conclusion seems to have been drawn that they require such a soil. It is possible that many of them are grown on such soil, not because they require that particular kind, but because they can get along better on such than can many of the other staple crops. Much evidence is available which shows that excellent yields may be obtained on the heavier soils, particularly the clay loams, providing the latter are well drained and well supplied with organic matter. An abundance of humus in the soil is essential for good yields. A clover or alfalfa sod makes an excellent seed bed.

Fertilization. Manure is an excellent fertilizer with which to increase the yield of potatoes, but it is not extensively used. Where manure is not applied, a fertilizer carrying potassium is necessary. The more useful commercial fertilizers for potatoes analyze relatively high in phosphorus and potassium and low in nitrogen. On sandy soils a 2–12–6 would be satisfactory. On good clover or alfalfa sod, the nitrogen may well be omitted. Liberal applications are usually most profitable, 400 to 800 pounds per acre being common. In the eastern states, where the land has been under cultivation longest, applications of 1,000 to 1,500 pounds per acre are not uncommon.

Fertilizer applied in the row results in rather better yields than when broadcast, but anything in excess of 800 pounds per acre should be drilled evenly over the surface. One disadvantage of applying fertilizer in the row is that the following crop may be uneven or "streaked."

Rotations. Potatoes are best grown in rotation with other crops, as potatoes, wheat, and clover; potatoes, oats, and

clover; or potatoes, strawberries, and clover. In short rotations like these, less difficulty is experienced with grub worms than is the case in plowing under old sods. If potatoes are not grown in rotations, but instead are grown continuously on the same land, they are more subject to outbreaks of diseases and to attacks of insect pests. On acid soil the other crops in the rotation may require lime, and wherever this is the case the lime should be applied to the crop following potatoes rather than to the potato crop itself. Otherwise many scabby potatoes may be produced.

Seed bed. Where conditions are such that fall plowing is inadvisable, the potato ground should be plowed in the spring as early as possible. The seed bed should not be too firmly packed. On the other hand, it should be left rather loose underneath and smooth on top. If the soil is too fine underneath, then in case of heavy rains the seed may produce a weak plant, or perhaps no plant at all, owing to smothering.

The seed. Firmness, soundness, and freedom from disease are leading qualities of good seed potatoes. If such potatoes are not available at home, then the use of northern-grown seed may be advisable. Being stored under more favorable conditions, northern-grown seed usually comes out of storage in the spring in better shape than that produced in a warmer climate. In order to make certain that potatoes are free from diseases and of good quality, it has become the custom in many localities to examine the crop carefully both in the field and again after harvest. Potatoes which pass successfully these inspections are known as certified seed. Corn Belt farmers hold in high esteem certified northern-grown seed. In some sections potato diseases are so prevalent that it is necessary to get new seed each year. Some farmers, however,

attribute failure of the potato crop to "running out" of the variety, but the better growers are of the opinion that with good culture and the use of clean seed any variety may be grown indefinitely without change.

Varieties. In recent years varieties of potatoes have been greatly standardized. At the present time commercial production centers around six varieties or, as they are more correctly called, six groups of varieties. These groups are further divided into two general classes—late maturing and early maturing. The name of the various groups and the chief characteristics of each are indicated in the accompanying outline.

Late Maturing:
- Rurals—blue pigment in sprouts and stems
- Green Mountain—no blue pigment, sprouts white, stems green (an eastern variety)
- Burbanks—Also green stems (grown largely in irrigated West)

Early Maturing:
- Triumph—red tubers
- Irish Cobblers—white tubers
- Early Ohio—white tubers tinged pink

Commercially, the late groups are the most important, and the Rurals are the most popular.

Planting. For planting, the "seed" tubers are cut into pieces weighing from one to two ounces and having at least one "eye" on each piece. The number and vigor of the sprouts developing from a seed piece depend on the size and not on the number of eyes. Each eye is a cluster of buds. One eye is sufficient, and gives the same results as a piece with a greater number of eyes.

Early potatoes should be planted as soon as the soil can be worked in the spring. Late potatoes are usually planted so that they mature at the time of frost in the fall, usually having a growing period of 120 to 150 days.

The quantity of seed required per acre varies from 8 to 25 bushels. Early potatoes make less growth than late ones; consequently they should be planted closer together, and thus more seed is required. Ordinarily potatoes are planted in rows 36 inches apart to allow for horse cultivation; and the late ones are usually dropped 12 to 18 inches apart in the rows. Where the potatoes are grown in a large way for commercial use, machine planters are usually employed.

Cultivation. After the potatoes are planted, but before they are up, it is well to harrow the ground several times lengthwise of the rows. Cultivation should begin as soon as the potatoes are up. Late cultivation should be more shallow than the early ones, and should be discontinued altogether as soon as the plants become so big that injury results from contact with the cultivator. A slight ridging is usually made at the time of the last cultivation. This prevents the potatoes from growing out of the ground, but is not desirable except in regions of abundant rainfall, because it results in the exposure of a greater soil surface, and consequently the loss of more water by evaporation.

FIG. 201. *Digging potatoes with a horse-drawn potato digger*

Harvesting. As soon as the vines are dead, potatoes are ready to harvest. Small patches are usually dug by hand, usually with a potato fork or a potato hook. Frequently they are plowed out. After they are picked up, the ground should be harrowed in order to uncover any that may have been overlooked. On a large scale, potatoes are ordinarily dug with a potato digger. From four to six acres a day may be dug with the use of a machine, while in hand digging one-half acre is regarded as a day's work.

Storage. During the period of storage, potatoes often lose 10 to 15 per cent, and in the case of badly diseased ones the loss may be much higher. The most favorable temperature for keeping potatoes is 36° to 40° F. Such temperatures are high enough to prevent freezing on the one hand, and low enough to prevent sprouting on the other. Good ventilation is helpful if potatoes are infested with rot.

Enemies. Success in growing potatoes depends in large measure on the effective control of their enemies, which include both insect pests and fungous diseases. Hopper-burn, frequently miscalled blight, is really caused by a small insect called the leaf hopper. This disease is characterized by a dying of the tips and edges of the leaves followed by a curling up of the blackened edges. Soon the middle portion of the leaves also die, and a few days thereafter the stems themselves succumb. Fortunately the sprays used for true blights are effective in driving off leaf hoppers.

Another destructive potato insect is the Colorado beetle, or common "potato bug." The small yellow eggs laid in clusters on the leaves are familiar to all boys who have helped "bug" potatoes. As soon as the eggs hatch, the larvae begin to eat the leaves, and unless killed they may devour them completely. This beetle may be largely controlled by spraying with arsenate of lead.[1]

[1] Arsenate of lead powder 1½ pounds, water 50 gallons.

The flea beetle may do considerable damage. This is a small, flealike, leaping creature which eats the leaves full of holes. It can be pretty well controlled by spraying with Bordeaux mixture. This mixture usually consists of 4 pounds copper sulphate and 4 pounds of stone lime to 50 gallons of water.

Potatoes are also attacked by a class of ailments sometimes spoken of as degeneration diseases, such as leaf roll, mosaic, spindle tuber, and others. These diseases cause certain distortions in the shape and color of the leaves, and plants afflicted with them give a reduced yield. These diseases are borne in the tubers. They are hard to recognize because under some conditions, such as high temperature, the leaflets of healthy plants may curl up and thus resemble the leaf-roll disease. They are spread from plant to plant by means of insects, particularly aphids. The best remedy is to use certified seed. They are not controlled by any method of spraying.

Probably the most serious disease to which potatoes are subject is late blight. In this disease dark spots, moldy on the underside, appear on any part of the leaves. They are accompanied by the development of an offensive odor. The infection spreads to the stems and to the tubers themselves, causing the development of dark-colored areas on the surface of the latter and a change in color of the interior to a rusty brown. Finally the potatoes rot, and the rotting usually continues after the potatoes are put in storage.

Early blight is also a serious disease, but it does not affect the quality of the tubers. It is characterized by the appearance on the leaves of small grayish-brown target-like markings which finally merge, giving large areas of withered leaves. The spots may appear while the plants are quite young, although it is more common for them to develop about the time the tubers begin to set.

Both late and early blight are controlled by spraying with Bordeaux mixture. In many localities dusting with copper-lime dust is coming to be used instead of spraying with Bordeaux.

Scab is one of the older diseases of the potato, and one which affects no part of the plant except the developing tubers. Its presence is shown by the formation of rough scabby areas, and in extreme cases these may cover the entire surface. The growth may penetrate the flesh to a depth of a quarter of an inch. Scab mars the appearance of potatoes and in bad cases it may render unsalable the entire crop. The nature of the disease is such that it can be held in check by treating the seed with corrosive sublimate,[1] by planting the crop in different fields year by year, and by avoiding the use of manure and lime in connection with the preparation of the seed bed.

In some sections considerable loss is sometimes caused by certain other diseases such as rhizoctonia, fusarium, and black leg. Rhizoctonia often kills the young shoots, thus causing a poor stand and a low yield. In this disease the tubers appear to have on them small specks of dirt, but these will not wash off. The food value is not affected. The disease may be held in check by treating the seed with corrosive sublimate.

Fusarium causes a reduction in yield, and may cause decay in storage. Rolling and wilting of the leaves and premature death are characteristics of this disease. It cannot be controlled by any known soil or seed treatment. Crop rotation helps to hold it in check.

Potato plants afflicted with black leg have an unthrifty, dwarfed appearance and the leaves tend to fold along the

[1] Corrosive sublimate:

Mercuric chloride...	4 ounces
Water	30 gallons
Time of treatment..	1½ hours

midrib. The stems become blackened at or below the surface of the ground and frequently break off if one attempts to pull them. If the stem end of an infected tuber is cut off, a brown coloration is exposed. This disease is best controlled by planting disease-free seed.

SWEET POTATOES

Although the sweet potato is spoken of as a tuber, it is in reality an enlarged root. It is served in a variety of ways as a table vegetable, and is often used for pies. The cull potatoes make good dairy feed. As a stock feed it is more highly prized than is the Irish potato because it is richer in carbohydrates, particularly the sugars, and in fat.

For home use sweet potatoes may be grown as far north as Lake Erie, but they are strictly a southern crop, being staple in the southern states only. Over half the total crop is grown in the states of Virginia, North Carolina, South Carolina, Georgia, and Alabama.

ROOT CROPS

In the northern states root crops are often grown to furnish succulent feed for live stock, particularly dairy cows, and for poultry. However, more and better succulent feed can be produced cheaper with corn than with root crops. For that reason the growing of root crops is confined largely to the smaller farmers, the ones whose herds are too small to warrant the erection of a silo. Some large dairymen, however, grow a few acres of root crops to mix with their silage because they

FIG. 202. *A mangel-wurzel*

feel that they serve as a good tonic. Root crops are often used to good advantage as a substitute for silage while cattle are out on the show circuit.

Mangel-wurzels are the most extensively grown root crop. They succeed on a variety of soils, but do best on

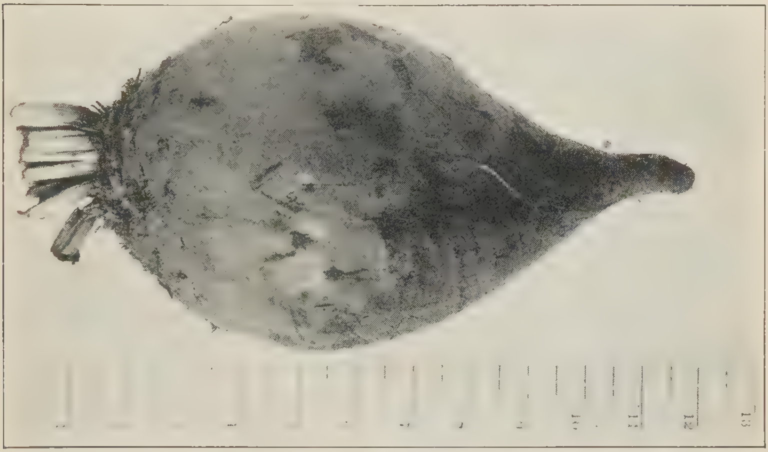


FIG. 203. *A champion yellow beet*

rich, well-drained loams. A clean seed bed should be prepared, otherwise weeds crowd out the seedlings, because the germination of the seed and the early growth of the plants are slow.

Mangels are usually seeded from May 1 to 20, and in rows 28 to 36 inches apart, using 5 to 10 pounds of seed per acre. They are cultivated about the same as corn. As soon as the plants have developed about four leaves they should be thinned, leaving 8 to 12 inches in the row between the plants. In harvesting they may be pulled by hand or removed with a beet lifter. In the absence of a root cellar mangels may be piled in ricks and covered with alternate layers of straw and earth, more earth being added as the intensity of the winter increases.

FIG. 204. *A rutabaga*

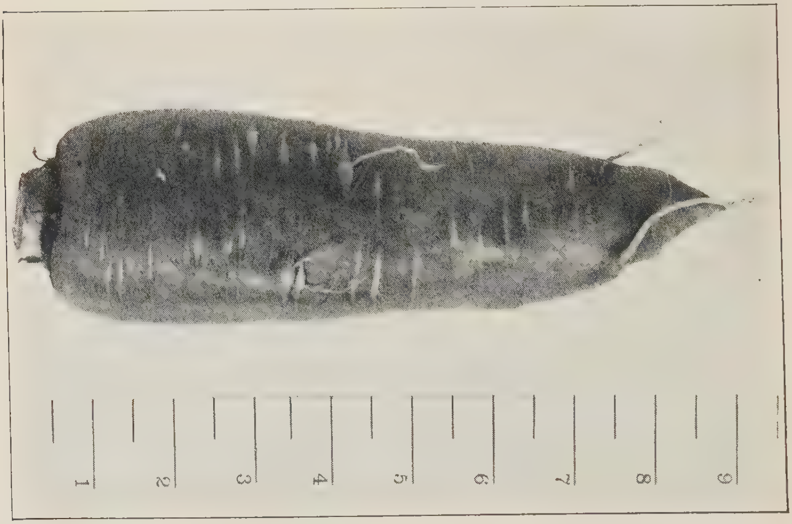


FIG. 205. *A carrot*

Other roots. *Table beets* and *rutabagas* are sometimes grown and fed to live stock the same as mangels.

Cowhorn turnips may be sown successfully any time from April to August. They may be broadcast alone, using 4 to 6 pounds of seed per acre. Sometimes they are broadcast in oats or corn at the time of the last cultivation,

FIG. 206. *Cowhorn turnips*

using 2 or 3 pounds of seed per acre. In either case they may be pastured with hogs or sheep after the removal of the main crop.

Carrots. As a stock feed carrots are fed chiefly to horses. They require a rich soil and a clean seed bed. Carrots are usually planted in May or June in rows 24 to 28 inches apart, using 3 to 4 pounds of seed per acre. They should be thinned, leaving spaces 4 to 6 inches wide between the plants. They should be pulled before the ground freezes, and placed in storage where it is cool and dry.

QUESTIONS

1. Discuss the origin of potatoes.
2. Name an important climatic factor in the distribution of potatoes. At about what temperature do they thrive best?
3. In what countries are the majority of the potatoes produced?
4. Name the chief potato-producing states in the United States.
5. What kind of soil is preferable for potatoes?
6. Name the principal groups of potatoes and the chief characteristics of each.
7. Discuss the planting of potatoes, including such things as the time, the rate, and the kind of seed pieces.
8. What are the principal insect pests and fungous diseases?
9. By what method can these be most effectively controlled?
10. What are the usual methods of harvesting?
11. Name the more essential conditions of storage.
12. Where are sweet potatoes chiefly grown?
13. For what purpose are root crops chiefly used?
14. Name the more important root crops.

PROJECT LESSONS

Exercise I

Object. To determine the comparative yield of certified and uncertified seed.

Procedure. Find out the yield obtained by each of a half dozen farmers using certified seed and a half dozen using uncertified seed. Determine the average yield obtained by each group of farmers. Did the certified seed yield any better than the uncertified?

Exercise II

Object. To find out the kind and quantity of root crops grown in the community.

Procedure. From each of a few farmers find out the following:

a. Size of farm on which root crops are grown
b. Area devoted to root crops
c. Kind of root crops grown
d. Use to which roots are put

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CHAPTER XXVII

CORN

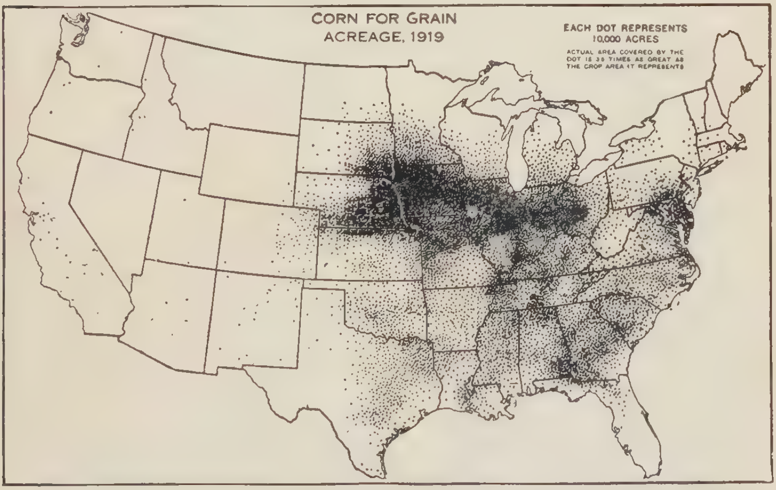
ORIGIN AND IMPORTANCE

When Columbus landed in the West Indies, in 1492, he found corn in common cultivation among the Indians. Columbus was so favorably impressed with the possibilities of this plant that he carried seed of it back to his home country, Spain. In Europe all the cereals are spoken of as corn. In order to distinguish this new plant from other cereals such as wheat, it was called Indian corn. History records that one of the prominent Indians, Squanto, taught the early settlers how to grow the crop and how to make food from it. On one or two occasions it is said that the corn crop saved the colonists from starvation. So thankful were the Pilgrims to the Indians for their kindness that in a year of bountiful harvest they held a public thanksgiving to which they invited the Indians. This was the origin of our Thanksgiving Day.

Origin. Practically all our cultivated plants are improved types of some wild form. People who have made a close study of plants are usually able to trace the relationship between the improved form and the original wild form. Corn is a grass, as are also oats, wheat, and other cereals. There are two wild forms of grass quite similar to corn. These are gama grass and teosinte. Both of these forms grow wild in Mexico. This and other evidence have caused most authorities to believe that the corn plant, as we know it, was developed in Mexico.

Importance and adaptation. The world's corn crop exceeds 3,000,000,000 bushels per year. About 80 per

cent of it is produced in North America, approximately 12 per cent in Europe, and the greater part of the rest in the Southern Hemisphere, chiefly South America and Australia. A very small quantity only is produced in Africa and Asia. Of all the corn produced in North America, practically 97 per cent is grown in the United States, and approximately 54 per cent of that cultivated in the United States is harvested in the seven states known as the Corn Belt—namely, Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, and Nebraska. The distribution of corn production in the United States is illustrated in Figure 207 below.



Courtesy United States Department of Agriculture, *Yearbook*, 1921

FIG. 207. *Corn production map*

The Corn Belt is characterized by a mean temperature of 70° to 80° F., an annual rainfall of 25 to 50 inches, and a growing season ranging from 125 to 150 days. Cool nights are not favorable for the growth of corn; for that reason it does not thrive well in the northern United States. Corn production in the West is limited by insufficient and

unequal distribution of rainfall. High yields are dependent on ample rainfall, particularly in the month of July.

The corn plant. On fertile soils corn often grows to a height of twelve feet or more. To support the stalk in an erect position and to gather nutrients from the soil, the corn plant has an extensive fibrous root system. Toward maturity the space between the rows may be completely filled with roots, and under many conditions they may extend to a depth of six or seven feet into the ground. The roots are thrown off in whorls, the first usually forming about an inch below the soil surface regardless of the depth of planting the seed. Several whorls develop one above another and the entire group is known as the "root-crown." From the first nodes just above the surface of the ground many short roots develop. They help to anchor the plant and are known as "brace" or "prop" roots.

FIG. 208. *Brace or prop roots on corn*

The stalk itself is not hollow like that of oats and wheat, but instead the center is filled with pith. The pith enables the stalk to sway to and fro in the wind without breaking. At irregular intervals in the stalk, joints or nodes occur. These are composed of solid material, and they materially strengthen the stalk.

At the base of the stalk where most of the strength is needed, the nodes are closest together. The space between two nodes is called an internode. Each internode is grooved on the side inclosed by the leaf sheath. The corn plant may produce "suckers." These are secondary branches coming from the lower nodes and they correspond to the "tillers" of oats and wheat. "Suckers" are not desirable, for they rarely produce ears, and yet they are greedy "feeders."

At each node a leaf develops. The lower part of the leaf, called the leaf sheath, surrounds the stalk for some distance and, while green, strengthens it. At the point where the leaf bends away from the stalk there is a little growth which clasps tightly round the stalk, and because it tends to prevent water from running in between the stalk and the leaf sheath it is sometimes called a rain-guard.

On each stalk two kinds of blossoms develop, the staminate and the pistillate. The staminate flowers are borne at the top of the stalk on the "tassel," and they produce pollen. The pistillate flowers are produced on the "cob," which is borne on a modified branch called the "shank"

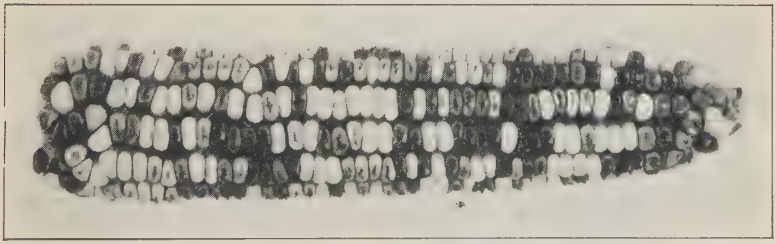


FIG. 209. *An ear of mixed corn*

and is surrounded by "husks." Each pistillate flower sends out a long threadlike structure, and these emerge in a cluster at the tip end of the ear and are known collectively

as the "silks." If all the silks receive pollen a well-developed ear is formed, but if some do not there will be some "blasted" kernels. If pollen from a different kind or variety of corn is brought by the wind and falls on some of the silks, a "speckled" ear may be formed. If pollen fails entirely to reach the silks, they grow indefinitely and sometimes attain considerable length.

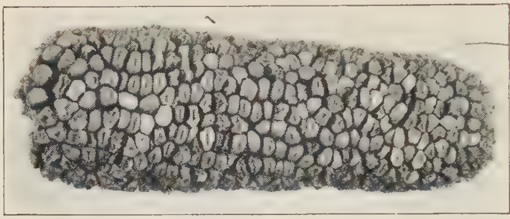


FIG. 210. *A few silks received pollen from sweet corn*

FIG. 211. *Silks which received no pollen*

Kinds of corn. Six distinct types of corn are usually recognized — pod, pop, soft, sweet, dent, and flint. The distinguishing characteristics are based largely on the structure of the kernels.

Pod corn. The kernels of pod corn may be a modification of any of the other

types. The corn is so named because of the fact that each kernel is surrounded by a separate husk or pod. It is thought by some to be the original corn from which modern types have been derived. It is grown only as a curiosity.

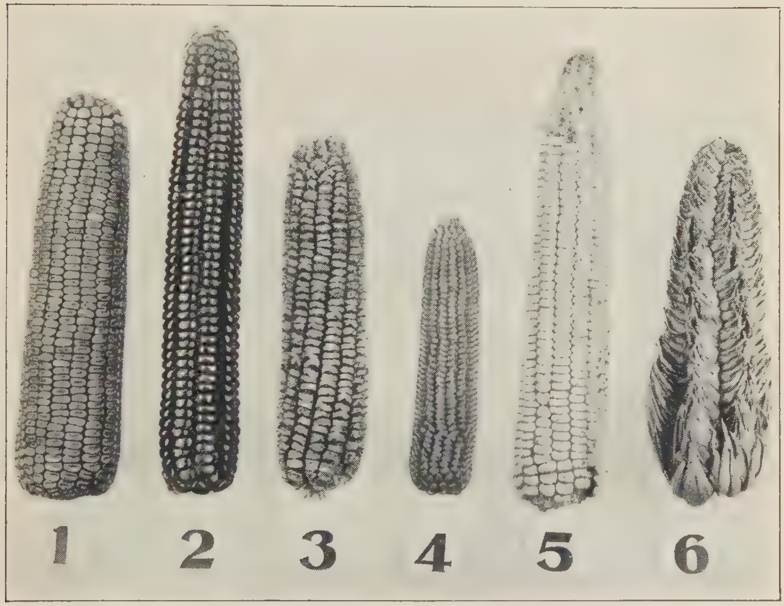


FIG. 212. *Six types of corn: (1) dent corn; (2) flint corn; (3) sweet corn; (4) pop corn; (5) soft corn; (6) pod corn*

Pop corn. The kernels of this type of corn are very hard and flinty. The corn is so named because when heated it "pops," or turns inside out, forming a fluffy mass. The explosion is thought to result from pressure developed by changing the moisture of the kernel into steam.

Soft corn. The contents of the kernels of soft corn may be easily crushed into flour. The softness is due to the fact that the interior consists largely of soft starch. This corn is not commonly grown except in the southern part of the United States, Mexico, and Central America.

Sweet corn. The mature kernels of sweet corn are somewhat shriveled and wrinkled. The contents of the kernels are not converted into starch, but consist of sugar-like compounds which give a delicious flavor to "roasting ears."

Dent corn. About one-half of the kernel in dent corn is soft starch. The remainder is hard and flinty. It is called dent corn because a depression or dent always forms at the top of the kernel. This is the corn of greatest agricultural value and the type most extensively grown in the great American Corn Belt.

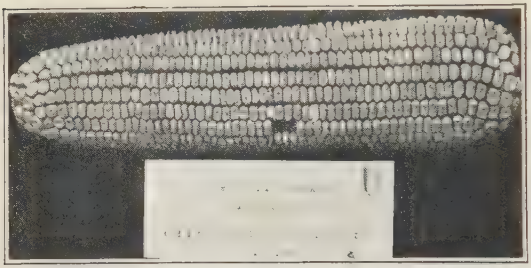


FIG. 213. *A champion single ear of dent corn. Note the depth and evenness of kernels*

Flint corn. The kernels of flint corn contain a small quantity of soft starch in the center of the kernel. Most of the kernel structure is hard and flinty. No dent forms at the top of the kernel. This corn can mature in a short season, and for that reason it is grown chiefly in New England and in the states to the north of the Corn Belt.

Color of corn. Of the dent types, there are several hundred varieties. These vary as regards yield, time of maturity, color, etc. Although there are purple, blue, and mottled colors, most varieties are yellow or white. Formerly it was thought that the feeding value of yellow and white corn based on chemical analysis was equal, but in recent years it has been found that yellow corn contains a principle, vitamin A, not found in white corn. Yellow corn, therefore, is preferable to white corn. If the white corn, however, is fed in connection with some green feed such as alfalfa, which also contains vitamin A, then it gives as good

results as yellow corn. Vitamins tend to prevent disease, stimulate appetite, and thus encourage growth.

Prolific corn. As a rule, most varieties of dent corn bear one ear to the stalk, but sometimes, especially on fertile soils or in thin plantings, the stalks bear two or three ears. However, there is a branching form of dent corn, thought by many to represent primitive corn, which frequently bears six or more ears.

Corn clubs. In the United States the average yield is approximately 30 bushels per acre. In the leading Corn Belt states the average yield is 38 bushels per acre. Boys working in corn clubs have been able to raise over 150 bushels per acre. The state of Ohio has a ten-acre 100-bushel corn club. Anyone is eligible to membership in the club who is over eighteen years of age and who can raise

Courtesy Ohio State University, Columbus

FIG. 214. *Ira Marshall and the field of corn which produced 1,686 bushels on ten acres of land*

1,000 bushels of corn on ten acres. Over one hundred men are now enrolled in this club. In 1926 the state championship was won by Ira Marshall, who raised 1,686 bushels on

ten acres. It is hoped that a study of this chapter will enable some boy or girl to help boost the average yield of corn in his or her state. One of the essentials in the production of a bumper corn crop is the use of good seed.

THE SEED

The variety. Of first importance in the choice of seed is the selection of a good variety. The most important characteristic of a satisfactory variety is that the size be such that it will mature in the average length season. Large, late varieties are objectionable because in most seasons they do not mature, and the growing of them often results in the production of much "soft" corn. Varieties imported from a long distance are usually less satisfactory than are the best local sorts. Occasionally it may be advisable to import seed from a good grower, but it is always well first to consult your county agricultural agent regarding home-grown varieties.

The ears. Having a good variety is not enough. We want the best ears in a variety. The most favorable time at which to select such ears is in the fall, in the field, from the standing stalk. By selecting from the wagon at husking time or from the crib at planting time, one does not have the opportunity to observe either the parent plant or the conditions of growth. Excellence in appearance of ears may be due either to environment or to heredity. Ears the excellence of which is due to the fact that they grew on a rich spot in the field, or where the stand of plants was thin, are often poor yielders. High-class ears due to heredity are preferable.

Storage of ears. The best of ears are often injured through careless handling and storage. To prevent injury from freezing, the ears should be well dried out before the coming of cold weather. Ordinarily this can be done by

providing for a free circulation of air around the ears. Some of the devices in common use for this purpose are shown in Figures 215, 216, and 217.

In unfavorable years, seed corn should be placed where it will have the benefit of artificial heat, as in a room through which a stovepipe passes or in a furnace room. After corn is dried out, it may be stored in well-ventilated boxes where it will be safe from rats, mice, and other vermin.

Corn judging. The careful corn grower always saves more ears than he actually needs, so that in the first choice he may do some culling. In any lot of seed ears there is much variation in regard to such points as length, circumference, filling of tips and butts, number of rows, roughness of kernels, and percentage of grain. Experiments conducted at the Ohio Station show that none of these characters influences materially the yield of grain. In other words, it is not possible to pick high-producing ears on the basis of their external appearance. The best that can be done is to select ears in the fall from the standing stalks growing under uniform conditions of stand and fertility; thoroughly dry them out before freezing weather; store

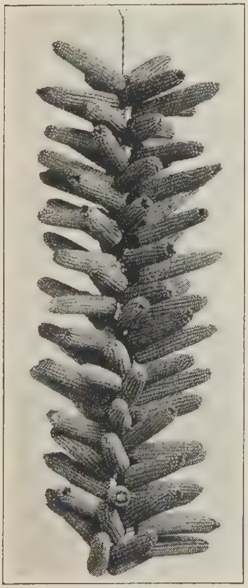


FIG. 215. *One method of drying seed ears*

FIG. 216. *Another method: woven with binder twine, the ears may be handled conveniently*

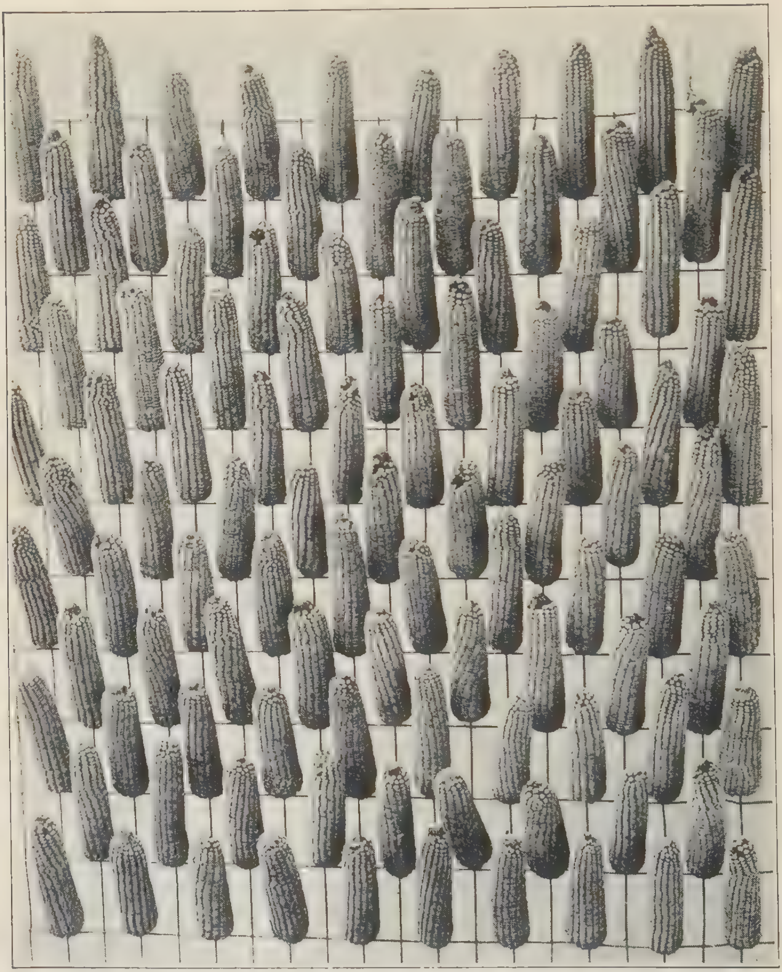


FIG. 217. *Still another method of drying seed ears: wire fencing used as seed-corn rack*

them safely and in the spring, after cold weather is past, test each ear to see if the kernels will grow.

Vitality of ears. A high yield of corn is dependent on a full stand of plants, but a perfect stand of plants is

impossible if poor seed is planted. Ears on which all or a part of the kernels will not grow and those which develop weak and inferior plants should be discarded. Such undesirable ears may be eliminated by testing the seed. So great may be the loss from the use of untested seed that several boys in Ohio obtained a yield enough higher from the use of tested seed to pay them on the average of $6.50 per hour for the time spent in doing the work.

FIG. 218. *Strong and weak germination*

Grading the kernels. Experiments have shown that butt and tip kernels will yield as well as those from other parts of the ear. Often, however, these kernels are irregular in shape, and hence do not drop evenly; for that reason, they should be discarded. These and other odd-shaped kernels may be easily eliminated by passing all of the shelled corn through a grader. In this way uniformity of kernels for planting is secured.

GROWING THE CROP

The soil. Corn is grown on a great variety of soils, but it thrives best on warm, well-drained, fertile loams and silt loams. On poor soil the yield of corn may be greatly increased by the use of manure and acid phosphate. In order to avoid loss through leaching in the barnyard, it is best to haul the manure directly from the stable to the field and distribute it immediately with a good manure spreader.

Seed bed. If the texture of the soil is such that it will not wash badly, it is well to do as much as possible of the plowing during the late fall and winter months. This saves much valuable time in the spring during the rush of work usual at that season of the year. Soils that cannot be safely plowed in the fall should be plowed as early as possible in the spring.

The seed bed should be thoroughly prepared. It should be firm and fine with plenty of loose earth on the surface with which to cover the seed nicely. The amount of fitting and kind of tillage implements required will be determined by the soil and seasonal conditions. A disk harrow, roller, cultipacker, and spike-tooth harrow will be found useful.

Time of planting. No best calendar date can be given for any locality. The desirable date varies with the locality, soil, and season. Perhaps the old saying of our ancestors is still the best advice: "Plant corn when the leaves of the white oak are as big as a squirrel's ears." Late planting, however, should be avoided. As a rule, early planted corn is best. It not only yields higher than late planted corn, but the quality of the grain is superior. It is true that early planted corn is sometimes frosted, but seldom does it fail to recuperate. Corn suffers much less from spring than from fall frosts. In Ohio, after the weather becomes

favorable, experiments indicate that each day of delay in planting means a loss of approximately one bushel per acre in yield.

Rate of planting. The best rate at which to plant corn depends on the fertility of the soil and the purpose for which it is grown. A general practice is to plant in hills 42 inches apart each way, and to drop the kernels at the rate of three per hill.

Experiments have shown that a higher yield may be obtained by drilling the seed in rows than by dropping it

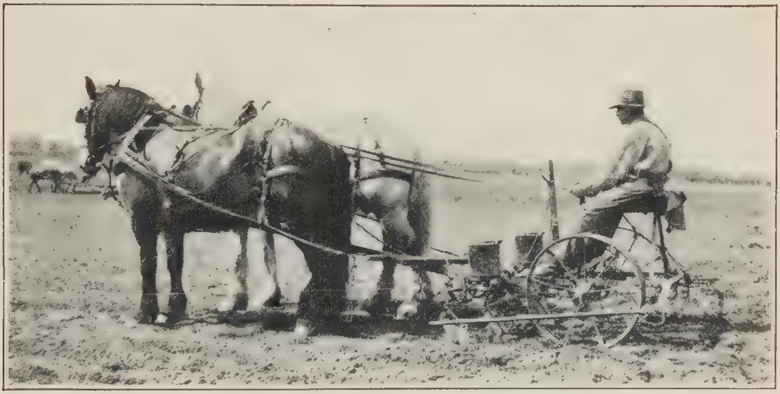


FIG. 219. *Check-rowing corn*

in hills. However, drilled corn can be cultivated in one direction only. In weedy fields, therefore, the extra cost of handwork required to keep the corn clean is usually more than the value in increase of yield. Notwithstanding this disadvantage, however, corn intended for the silo is usually drilled, the kernels being dropped 9 or 10 inches apart in the rows. Drilled in this way it gives a higher tonnage per acre and is handled better than hilled corn with the corn binder.

Depth of planting. Corn may be planted from 1 to 3 or more inches deep, the best depth depending on the

physical condition and moisture content of the soil. A more or less lumpy and dry seed bed requires deeper planting than does one which is well pulverized and moist. On a well-pulverized seed bed 1 or 2 inches is a good depth at which to plant.

Cultivation. The principal reasons for cultivating corn are to keep out weeds and to conserve moisture. There should be no halting in the working of corn ground after the seed is planted. Infrequent working not only gives the weeds a chance to start, but the surface may crust over and thus prevent the entrance of air which is necessary for the proper germination of the seed. It is well to go over a newly planted cornfield with a smoothing harrow. A spike-tooth harrow can be used if the teeth are adjusted to slant backward. For early working the weeder is an excellent tool, and the use of it may be continued until the corn is from four to six inches high. The fingers of the weeder remove effectively all the weeds, including those in the hills. A few plants may be uprooted, but the loss will be far less than the benefit.

As soon as the corn is big enough so that the rows may be easily followed, the use of the cultivator should begin. The first cultivation may be 3 or 4 inches deep and close to the rows. The loose dirt rolled into the rows covers and kills the young weeds. The depth of the second cultivation, made perhaps a week later, should not exceed 2 or 3 inches. The later cultivations should become increasingly more shallow, the last ones not exceeding 1½ to 2 inches. Shallow cultivation kills the weeds, provides a dust mulch to conserve moisture, and does not disturb the corn roots. It is well to remember that within five or six weeks after planting the corn roots occupy practically all the ground between the rows, and they also come close to the surface.

FIG. 220. *A weeder cultivating corn*

FIG. 221. *Cultivating corn*

The number and frequency of late cultivations should be such as to control the weeds effectively. Thus it will vary with the type of soil and the season. Ordinarily four to six cultivations are sufficient. Corn is usually "laid by" in early July. One or two later cultivations may be profitable in dry seasons.

Cultivators with many small blades are preferable to those having few but large blades. The newer types of cultivators carry numerous small shovels so constructed

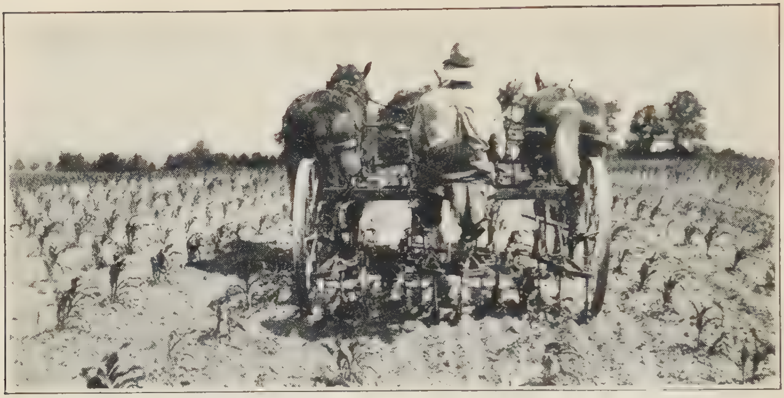


FIG. 222. *Cultivating corn two rows at a time*

FIG. 223. *Corn harvester at work*

and arranged as to insure thorough stirring of the surface soil. Some of the newer implements cultivate two rows at a time.

HARVESTING THE CROP

Shocking corn. There are many ways of harvesting the corn crop. In regions where the price of hay is high and

where the dairy industry is prominent, the general custom is to cut and shock the entire plant. In order to secure the best quality of both grain and forage, the corn should be cut when the husks are dry and when about one-half of the leaves are green. The cutting is done by hand or with a corn binder. In cutting by hand from 36 to 144 or more hills are cut into one shock, and the fodder is then bound round the top. The corn binder cuts and binds

FIG. 224. *When the fodder's in the shock*

the fodder and throws the small bundles onto the ground. They are later set up by hand.

After standing in the shock a few weeks, the corn should be dry enough to husk. The husking may be done by hand or with a husker and shredder. A corn shredder not only removes the ears, but it cuts the stover into fine pieces or shreds.

Snapping off the ears. In some sections it is common practice to "snap off" the corn, throwing the ears into a wagon and leaving the stalks standing on the ground to be plowed under. This method saves labor, but the plan is not generally followed except where labor is scarce and the need for roughage is not great.

Making silage. In dairy regions a large proportion of the corn crop is put into the silo and then called silage or

ensilage. Silage of best quality is made from corn regarded as just a little too green to cut and shock. If it is overripe and too dry, it will not pack well in the silo, and the silage is liable to mold unless a stream of water is run into the silo during the time of filling. This is an excellent way to

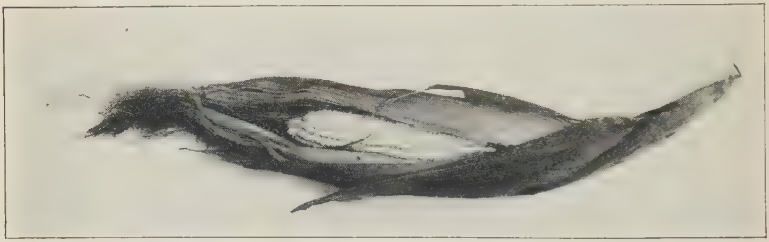


FIG. 225. *Corn ear at proper stage for the silo*

handle the corn crop, because it not only utilizes the entire plant but it furnishes succulent feed for livestock throughout the winter.

Size and capacity of silos. The accompanying table, which is adapted from *Farmers' Bulletin 855*, shows the relation between the size of the herd and the size of silo required to hold sufficient silage for six months' winter feeding.

DIMENSIONS AND CAPACITY OF SILO IN RELATION TO SIZE OF HERD

Depth of Silage in Feet Required for 6 Months' Feeding	Inside Diameter of Silo in Feet	Pounds of Silage in Depth of 2 Inches	Estimated Tons of Silage	Number of Animals That Can Be Fed, Allowing			
				40 Pounds per Head	30 Pounds per Head	20 Pounds per Head	15 Pounds per Head
32	8	325	32	9	11	17	22
31	9	424	39	11	14	21	28
30	10	524	47	13	17	26	35
30	11	634	57	16	21	31	42
30	12	754	68	19	25	37	50
30	13	885	80	22	29	44	59
30	14	1026	90	25	34	51	68

FIG. 226. *Cutting, elevating, and loading silage corn*

FIG. 227. *Filling a silo*

Field corn may be expected to yield 8 to 10 tons of silage per acre, while the later-maturing varieties will yield 12 to 15 or more tons per acre.

Hogging down. An exceedingly economical method by which to harvest corn is to turn hogs into the field and allow them to help themselves. This plan is impracticable in wet, muddy seasons and is rarely used to harvest the entire crop, even in dry seasons. Ordinarily a portion of the field is fenced off and the hogs are confined to that

portion. In hogging down, the corn ration should be supplemented with some nitrogenous constituent such as

FIG 228. *Hogging down corn, an exceedingly economical method of harvesting corn*

tankage or skim milk. In some localities hogs are finished for market in this way.

Shrinkage in ear corn. As corn comes from the field in the fall, the moisture content varies widely, depending on the degree of maturity. In Ohio, field corn commonly contains from 24 to 35 per cent of moisture on November 1, and between then and July 1 it may lose approximately 20 per cent of moisture. The loss is most rapid during the months of March to May inclusive. If corn is worth 50 cents a bushel on November 1, it should, in lieu of the loss of moisture, bring at least 60 cents by June 1.

THE USES OF CORN

Stock feed. Corn is one of the most abundant sources of food for the people of the United States. Outside of the South, however, perhaps not more than one-tenth of it is

consumed directly. About 90 per cent is fed to cattle and hogs and is, therefore, consumed indirectly as beef and pork. Under ordinary conditions of feeding, about 10 to 12 pounds of corn are required to produce one pound of beef, and about 5 to 6 pounds to produce one pound of pork. Corn meal, gluten meal, and corn cake are important by-products used in feeding live stock.

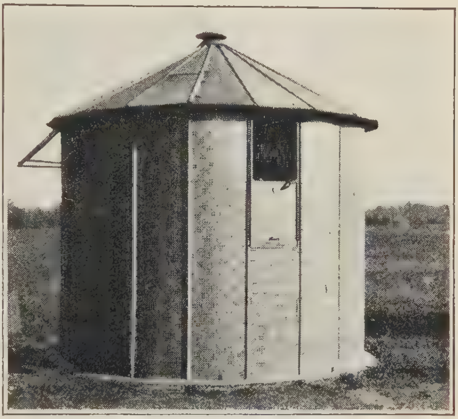


FIG. 229. *A modern corn crib*

Corn as food. Most of the corn used directly as food for man is consumed as roasting ears, canned or

FIG. 230. *A very convenient corn crib*

dried corn, pop corn, grits, hominy, and in various culinary products made from corn meal. Among the numerous products made from the grain are the various breakfast foods, corn oil, starch, alcohol, and glucose. From the latter are made sugars, candy, and sirups.

Manufactured products. Different parts of the plant are used in making numerous articles such as mattresses, doormats, upholstering, paper, gunpowder, mucilage, varnish, and films for moving pictures. The pith is used as packing in battleships because when wet it swells and, therefore, tends to prevent leaks.

ENEMIES OF CORN

Weeds. The principal enemies with which the corn grower has to deal are weeds, insect pests, and fungous diseases. Weeds use much plant food and moisture which otherwise would be available for the use of the corn, and in that way reduce the yield. Most weed difficulties can be handled by thorough cultivation. *Foxtail* is one of the most common and persistent weeds. *Lamb's-quarters* and *ragweed* are also quite prevalent. In rich bottom land *Spanish needles* and *bindweed* are often troublesome.

Insects. Corn is attacked by a large number of insects, but relatively few of them cause serious injury. The more common insects are the *wireworm, white grub, cutworm, corn rootlouse, corn rootworm, sod webworm, chinch bug, corn earworm,* and the *European corn borer.* By far the most destructive of all of these is the European corn borer, which was recently brought from Europe to North America in shipments of broom corn. It was

FIG. 231. *European corn borer moth—natural size*

first discovered in the United States in 1916 in the state of Massachusetts. The borer is usually thought of as a grayish larva or caterpillar about one inch long, because it is in this

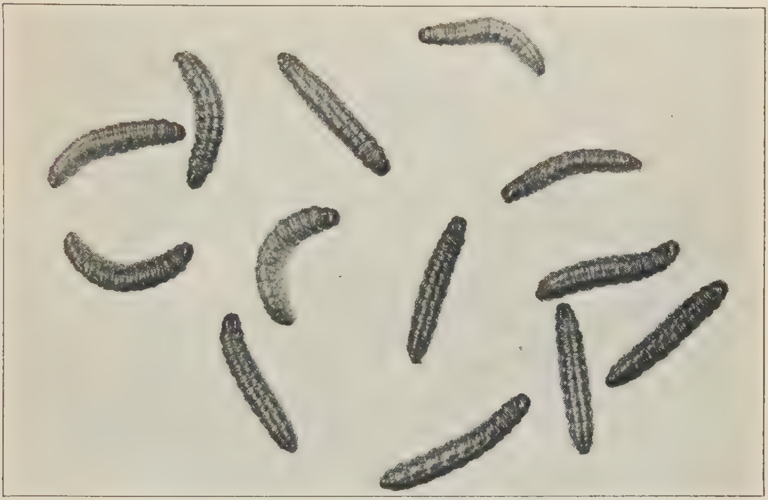
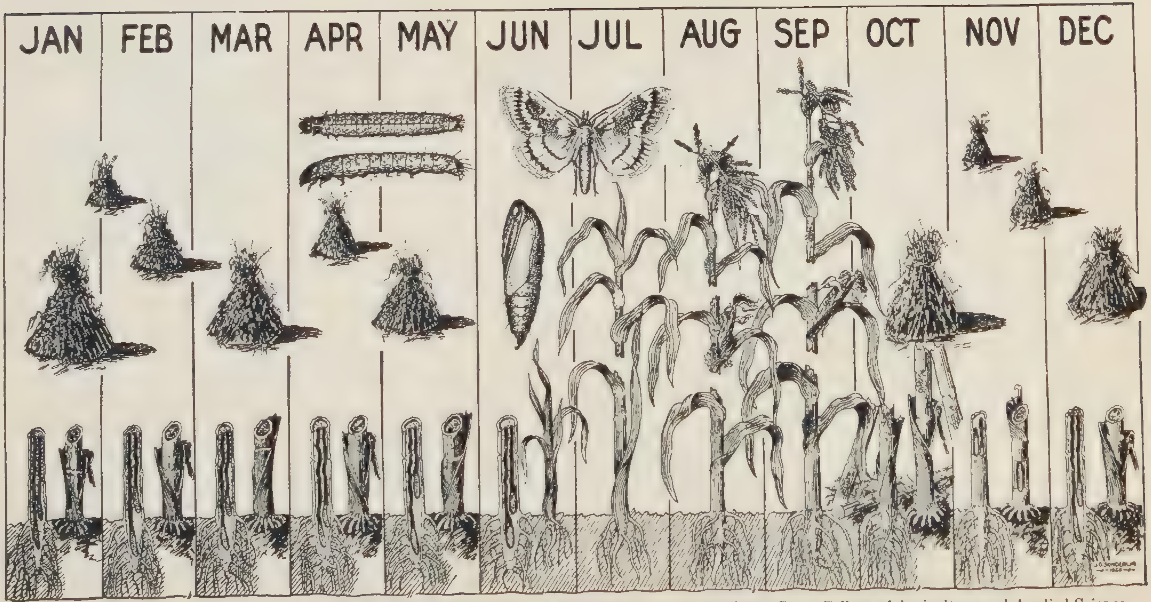


FIG. 232. *European corn borer larvae*

form that it spends the greater part of its life, tunneling up and down the stalks and into the ears, causing the damage to the crop. The adult form — a cream-colored moth — lays its eggs on the leaves and stalks the latter part of June and throughout July. Dispersion takes place chiefly at this time through flight of the moths, but the borer may be spread by the carrying of infested ears or stalks into uninfested territory, unless the latter is protected by rigorous quarantine.

The arrival of this pest may eventually necessitate material changes in the methods of growing the corn crop. Promising measures of control are being developed along these three general lines: (1) modified cultural methods, (2) mechanical devices, and (3) the introduction of parasites.

Corn planted two or three weeks later than normal has been found to suffer much less than does that planted at



Prepared by R. H. Pettit, Entomologist of Experiment Station, Michigan State College of Agriculture and Applied Science

FIG. 233. *Life-history chart of western brood of European corn borer*

the usual time. Implements are being devised which cut and shred the stalks at one operation and thus destroy a large percentage of the borers. Those contained in stalks put in the silo or fed in the feed lot are killed. Borers living in stubble or stalks which are burned or completely plowed under are also destroyed. Certain insect enemies or parasites which are known to feed upon and destroy the borer have been introduced. A search for others is being made

FIG. 234. *A field in Canada heavily infested with the European corn borer. This field had an average of more than thirty borers per stalk. The crop was an entire failure*

in those parts of the world where the borer has long been known to exist. Other and more destructive parasites may be found, but it will probably be many years before much help can be expected from this source.

Fungous diseases. Probably the most injurious diseases to which corn is subject are corn ear mold, root rots, and smut. *Corn ear mold* or *dry rot* is characterized by the development of mold which causes the husks to adhere to the kernels. It destroys the feeding value and weakens the germination of the seed. In infected areas the continuous cropping of corn should be avoided. In some

seasons and under some conditions the *root rots* cause considerable loss. The cause is due to several organisms. The selection of seed from disease-free plants is the most practical remedy. *Corn smut* sometimes causes considerable damage. It may attack the leaves, ears, tassels, stalks, or brace roots, converting the affected part into a mass filled with small black dirty spores. The spores may remain in the field from year to year, or they may be carried there in manure if smutted fodder is fed. Treatment of seed does not reduce the amount of smut. Cutting off and destroying the diseased parts several times during the season is the most effective remedy.

QUESTIONS

1. In what countries is the world's corn crop produced?
2. Prepare an outline map of the United States and shade the Corn Belt states.
3. Name the six types of corn and the distinguishing characteristics of each.
4. Is there any difference in feeding value between yellow and white corn? Why?
5. What is the average yield of corn in the United States? In your state? In your county?
6. Name four important characteristics of good seed corn.
7. What varieties are most satisfactory in your locality?
8. At what rate do you plant corn for seed? For silage?
9. Why do farmers cultivate corn?
10. Describe in detail how corn should be cultivated.
11. Is it a good plan to grow sweet corn near field corn? Why?

PROJECT LESSONS

Exercise I

Object. To find out the important ear characters of corn.

Materials. A pencil, score card, and ten ears of corn. For beginners a score card is helpful because it calls attention to the important points. However, it does not necessarily enable one to pick out the high-producing

ears. The use of it should be discontinued as soon as one has become familiar with the various points and has developed sound judgment regarding the relative value of each. A score card like the following will be found useful:

SCORE CARD FOR DENT CORN

Ear Characters		Perfect Score
Adaptability (40)	1. Maturity	30
	2. Size of ear	10
Seed condition (35)	3. Viability	20
	4. Diseases	10
	5. Injury	5
Show points (25)	6. Uniformity	10
	7. Shape of kernel	10
	8. Minor points	5

1. *Maturity:* This is of first importance in selecting seed ears. It is indicated by ripeness and firmness of ears and by complete filling out of kernels. Ears with a dull, faded, starchy appearance should be avoided.

2. *Size of ear:* The ears should be of such size as to mature in the average length season. Their weight can be determined by the use of scales after the corn is thoroughly air dry, but in many seasons this will not be practical before the first of January.

3. *Viability:* Viability is second in importance only to adaptability, for weak or dead kernels are worthless for seed. Indicated by solidity of kernels in the ear and by brightness of color. Blistered or discolored kernels or those with dark-colored germs should be avoided. The germs should be creamy white and waxy.

4. *Diseases:* Indicated by such things as mold on the kernels or cobs and by shredded and discolored shanks.

5. *Injury:* Indicated by evidence of weathering or by damage done by rats, mice, etc.

6. *Uniformity:* The ears should be uniform in size, shape, color, indentation, and size of kernel. Uncertain tints in cob and grain and off-colored kernels are evidences of mixture. All the cobs should be of the same color, white corn having white cobs, and yellow corn red cobs.

7. *Shape of kernel:* The kernels should be keystone in shape, uniform in thickness, and of good depth. Thin, shrunken, pointed kernels should be avoided.

8. *Minor points:* A little consideration should be given to such things as straightness of rows, space between rows and between kernels in the

row, the filling of butts and tips, the irregularity in shape of butt and tip kernels, the size of cob and shank. Swelled, open, or badly compressed butts should be avoided.

Procedure. Give the sample as a whole a mark on each of the eight points.

Conclusions. Add the several markings and note the final score.

Exercise II

Object. To find out what percentage of the corn will grow.

Materials. Unbleached muslin, pencil, cardboard, small nails, string, bucket of water, damp cloth, and ten or more ears of seed corn.

Procedure. Secure a strip of unbleached muslin 10 by 20 inches. With a heavy pencil mark lengthwise through the middle, then crosswise, leaving three-inch spaces. Number all of the spaces, putting odd numbers on one side and even ones on the other. Dampen the muslin and spread it on a table. Number each ear. This can be done by nailing a square piece of cardboard to the butt end of each ear and placing the number on it. Then from ear one remove six kernels, taking each kernel from a different part of the ear, and place them in space one. Continue in like manner until all the ears have been sampled. Then fold the end of the cloth over the first spaces and carefully roll it up. Tie a string loosely around the middle, and place the roll in a bucket of water for five or six hours. Then remove and place in a warm room under a damp cloth. In about a week the kernels should be ready to count out. How many ears show perfect germination? What is the average percentage of germination?

Exercise III

Object. To find out how much the yield may be reduced by having a poor stand of plants.

Materials. A field of corn, pencil, and paper.

Procedure. Go into a field of corn at harvest time and count the number of stalks found in twenty-five hills. Make such a count in twenty representative parts of the field. From the average of these counts estimate the percentage of a perfect stand for the entire field, assuming that each hill should contain three stalks. On an acre planted in hills 42 inches apart and at the rate of three stalks per hill there are 10,665 plants. Calculate the number of plants missing per acre in the whole field. Assuming that each plant produces a 12-ounce ear, then what was the loss in yield due to missing plants?

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CHAPTER XXVIII

WHEAT

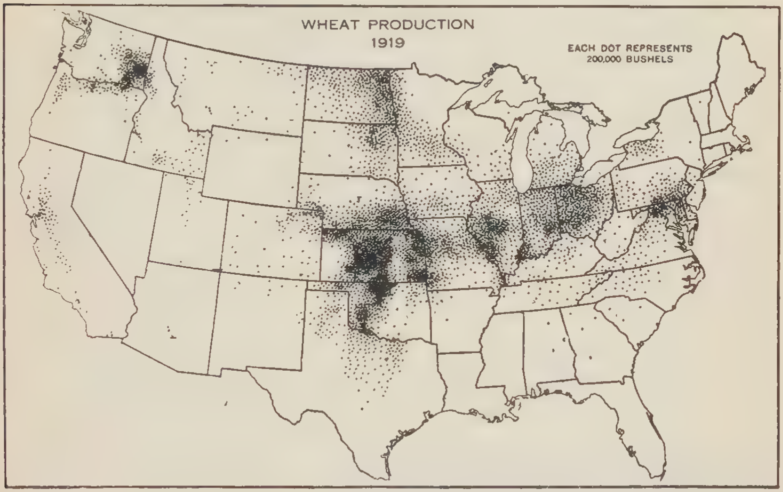
Early history. Wheat has been grown for so long that no one knows the exact time or place at which the culture was begun. Undoubtedly it had been under cultivation long before the beginning of recorded history. Kernels of wheat have been found in ancient Egyptian tombs. The Chinese are said to have cultivated it, probably in the year 3,000 B.C.

The beginning of cultivation is thought to have taken place in the valleys of the Euphrates and Tigris rivers, a center of ancient civilization. In recent years a wild form has been found in Asia Minor from which it is thought our common cultivated wheat may have been developed.

Adaptation. The distribution of wheat culture throughout the world is much more general than is that of corn. However, the quality of the wheat is materially affected by the wide variations in climatic conditions. For example, wheat grown in the more humid regions of the world is generally soft and starchy, while that grown in less humid territory is generally hard. On account of the alternations of seasons north and south of the Equator, and the variations in altitudes and latitudes at which wheat is grown, there is no month in the year in which wheat harvest is not in progress in some part of the world.

Production and distribution. The world production of wheat amounts to about three billion bushels annually. The principal regions in which it is produced are: (1) Russia, (2) the Mediterranean territory, (3) Europe, (4) central United States and Canada, (5) northwestern United States, (6) India, (7) Argentina, and (8) Australia. For

the five-year period 1920–1924, the United States alone produced about one-fourth of the world's crop. Nearly one-half of that grown in the United States was produced in six states, Kansas being the leading state. The distribution of the crop in the United States as it was grown in the year 1919 is shown immediately below in Figure 235.



Courtesy United States Department of Agriculture, *Yearbook*, 1921

FIG. 235. *Where wheat is grown*

The wheat plant. In structure and manner of growth the wheat plant is similar to the oat plant, which has already been described. However, the head is a spike rather than a panicle. And it may be bearded or non-bearded, and the glumes or chaff may be white or reddish in color and smooth or velvety on the surface. Furthermore, the wheat stalk is smaller and harder than the oat stalk.

Kinds or types of wheat. To meet the great variety of conditions throughout the world under which wheat is grown — variations in altitude, latitude, humidity, temperature,

etc. — there are eight distinct types of wheat. These are known as: (1) *einkorn*, (2) *spelt*, (3) *emmer*, (4) *common wheat*, (5) *club wheat*, (6) *poulard wheat*, (7) *durum wheat*, and (8) *Polish wheat*.

Einkorn, spelt, poulard, and Polish wheat are not grown in the United States except in a small or experimental way. Emmer is grown quite extensively in the semiarid regions of the Northwest, where it is utilized as feed for live stock. It is not used for the making of flour. Common wheat, as the name suggests, is the kind in universal culture on our farms. Club wheat takes its name from the club-shaped form of its head. This type of wheat is grown chiefly in the Pacific coast region. Durum wheat is the principal type from which macaroni is made.

The common and the club wheats are the two types extensively used in the making of bread, and about 95 per cent of the wheat crop consists of these two kinds. The wheats used in making bread and macaroni are often classified according to: (1) time of sowing, as winter or spring; (2) structure of kernel, as hard, semihard, or soft; and (3) color of grain, as red or white. On the market wheat is usually described by a combination of these characters, as soft white winter wheat or hard red spring wheat. White wheat is not in so great demand as red wheat. The white wheat flour makes good crackers and pastries, but poor loaves of bread.

FIG. 236. *The final test of wheat is in the bread made. Loaf No. 2 is coarser and more compact than loaf No. 1*

Uses of wheat. Practically all of the world's wheat crop is used in the manufacture of flour. Very little whole wheat

is fed to live stock, but in the milling process several by-products result which make valuable stock feed. Bran, shorts, and middlings are the most important of these

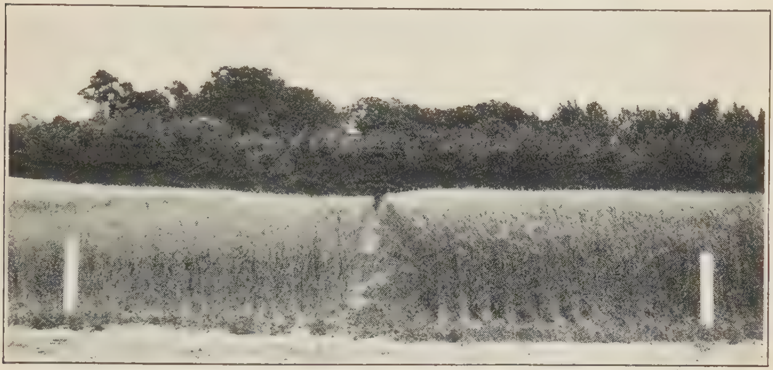


FIG. 237. *Left: no treatment for thirty-three years, yield 14 bushels; right: complete fertilizer for thirty-three years, yield 33 bushels*

feeds. If the entire wheat kernel, including all the bran, is ground, the product is known as graham flour, named in honor of Sylvester Graham, an American vegetarian and reformer. Most of the so-called graham flour, however, is made by mixing white flour of inferior quality with bran. Whole-wheat flour differs from graham in that most of the bran is removed. Wheat straw is valuable both as feed and as bedding.

Yield per acre. For the ten-year period 1915–1924 inclusive, the average yield of wheat in the United States was 14.1 bushels per acre. For the same period the average yield in the state of Ohio was 16.9 bushels. For the same ten-year period the yield on a forty-acre tract of the main farm of the Ohio Agricultural Experiment Station averaged 33.9 bushels. In two out of the ten years, the average yield exceeded 40 bushels per acre. In a ten-acre wheat contest Urban H. Troeger, living in Defiance County, Ohio, raised, in 1926, 633 bushels on ten acres, or 63.3 bushels per acre.

The more important requirements for raising a good crop are discussed in the following paragraphs. Perhaps a careful study of these may stimulate some boy to try to increase the yield of wheat in his neighborhood.

PRODUCING THE WHEAT CROP

Soil and fertilization. The quality of wheat is affected less by soil than it is by climate. But the soils, too, may vary considerably, although loamy soils are preferable. An abundance of organic matter is desirable for corn, but for wheat too much of this material often results in lodging, especially in rainy seasons.

Wheat is a cash crop, and for that reason it is more liberally fertilized than oats. A good wheat fertilizer contains a generous quantity of phosphorus, because this element is required in large quantities in order to develop plump kernels. Shriveled kernels often indicate a lack of phosphorus in the soil. Usually a fertilizer containing a little nitrogen is used in order to start the plants off vigorously in the fall. If the wheat plants lack vigor in the spring and the growth is backward, a light dressing of nitrate of soda will stimulate the growth and materially increase the yield.

Preparation of seed bed. A firm seed bed with two or three inches of loose soil on the surface is ideal for wheat.

The kind of preparation needed depends largely on the preceding crop. If wheat follows a crop such as oats or clover, the ground should be plowed—the earlier the better. It is well to roll and harrow immediately each half-day's plowing. After the plowing is finished, the harrowing should be repeated at intervals of a week or ten days, or as often as is necessary to control weeds and to conserve moisture. Frequent stirring also helps to make ready the materials in the soil required for the growth of the young

plants. In the final fitting there will be needed such implements as a good disk harrow, a smoothing harrow, a cultipacker, and a plank drag.

If the wheat follows some cultivated crop such as corn, potatoes, or soy beans, usually a suitable seed bed can be prepared by disking the ground. In fact disking is, in such cases, usually preferable to plowing. The amount of disking required will vary with the type of soil and with

FIG. 238. *Wheat requires a well-packed seed bed*

the thoroughness with which the preceding crop has been cultivated. Heavy clay soils will call for more preparation than will the light clays and loams.

Frequently corn ground is disk-drilled to wheat without any preparation. Unless the ground is very mellow this procedure is not advisable. Ordinarily corn is not cultivated after the middle of July. Between that time and harvest the ground usually becomes hard and dry and somewhat weedy. It does not make a satisfactory seed bed. To stop and disk the ground requires a few days of time, but the injurious effect of such delay will be more than offset by the benefits derived from the better preparation of the seed bed.

Potato ground requires less tillage than does corn ground, especially if the potatoes have been dug with a modern digger. However, some soil between the rows remains undisturbed, and in order to stir this the ground should be disked and then smoothed with a harrow or cultipacker.

The variety. Of first importance in the selection of seed wheat is the choice of a good variety. In selecting a variety one should consider not only the yield but also such things as the bread-making qualities, stiffness of straw, resistance to disease, and winter hardiness.

Many suitable varieties are available for most localities. The *Turkey Red*, *Kanred*, and *Kharkoff* are popular in the West. Such varieties as the *Poole* and *Fultz* are commonly grown in the central states. New and improved varieties are being developed from time to time by use of the same methods employed in the development of new varieties of

FIG. 239. *Variations of hardiness of different strains of Poole wheat*

oats to which reference has already been made. In an acre of wheat there may be from one to three million individual plants, and no two of them are exactly alike.

Some may be remarkably stiff in straw, others may possess high yielding capacity, and still others may be able to withstand extreme cold. These natural variations offer great opportunity for the improvement of varieties through selection.

FIG. 240. *Fultz wheat. The middle row shows weak straw, while the other two rows are stiff and erect*

Some good varieties have been developed by farmers. For example, in Civil War times Abraham Fultz, a farmer living in Pennsylvania, observed a plant without beards growing in a field of bearded wheat. He gathered the seed, sowed and multiplied it in his garden, and thus developed what has since been known as the Fultz variety.

One should choose a variety which experience has shown to be well adapted to local conditions. Grain dealers will usually pay a premium for uniform wheat of high grade. Therefore it is an advantage for all the farmers of a community to grow the same variety. Your county agricultural agent can assist in the choice of one of the latest and best adapted varieties. The seed should be thoroughly cleaned in a good fanning mill, and if this is done every year there is no danger of its "running out." On the farm of the Ohio Experiment Station some varieties have been grown without change of seed for thirty years, and they show no signs of deterioration.


FIG. 241. *Wheat head in bloom*

Time to sow wheat. Wheat should become well established in the fall, and for that reason it should be sown six to eight weeks before freezing weather is expected. In the latitude of the Great Lakes it should be seeded about the first week in September. Farther south it should be seeded later. October 1 is about the right time in the latitude of the Ohio River. In some years, however, wheat seeded at the normal time is greatly injured by the Hessian fly. In such seasons it is best to delay seeding until after the fly-free date. This is a date, discovered by entomologists, after which seeding of wheat can be made without danger of attack by Hessian fly. The safe date for seeding may be obtained by consultation with your experiment station or with your county agricultural agent.

In some parts of the wheat regions the winter is too cold for wheat to endure. In such localities wheat is sown in the spring as soon as the land can be well fitted, and the crop is known as spring wheat.

How much seed to use. Seedings made at different rates at the Ohio Experiment Station for a quarter of a century show that the most profitable quantity to use in that climate is 8 pecks per acre. In regions of more moderate rainfall, as for example in the Missouri Valley, 6 to 7 pecks per acre is sufficient.

Method of seeding. Practically all wheat in this country is drilled. Very little is sown broadcast. Drilling both ways, or cross-drilling, is seldom followed. In order to secure greater distribution of seed over the surface of the ground, there have been placed on the market in recent

years drills with hoes 4 instead of 7 or 8 inches apart. Experiment has shown, however, that the use of such drills does not materially increase the yield.

The best depth at which to sow wheat varies with the soil conditions. The seed should not only be nicely covered, but at the same time should be deep enough so that the moisture conditions surrounding it will cause prompt germination. On a poorly prepared seed bed, therefore, it is best to sow a little deeper than one would ordinarily drill on a seed bed of good tilth.

HARVESTING

Cutting and shocking. Wheat should be cut when the leaves and chaff have become yellowish in color and when the kernels are in the hard dough stage. If cut too green

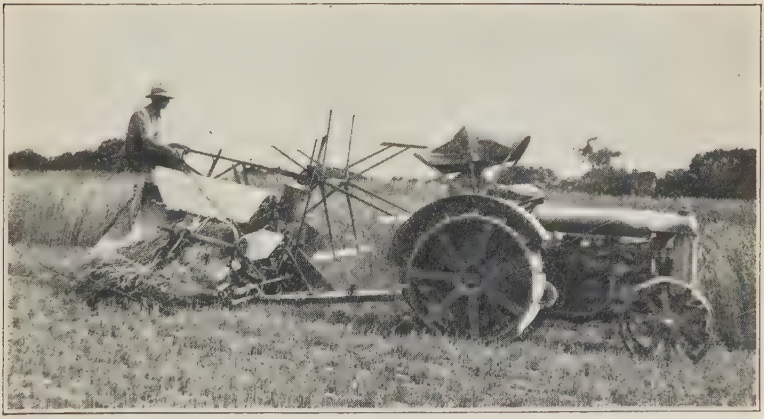


FIG. 242. *Harvesting wheat*

the grain is likely to be light in weight. If allowed to become overripe, there may be much loss from shattering in the harvesting operations.

The sheaves should be shocked as soon as possible after cutting. This prevents bleaching through exposure to dew

and rain. Wheat is usually shocked by setting up ten bundles and capping with two sheaves, thus making a dozen bundles to the shock.

Threshing. Wheat may be threshed directly from the field, or it may be stacked or mowed away in the barn and threshed after it has passed through the sweat. Threshing from the field is most economical, but it is risky in rainy seasons. Moreover, if the grain threshed from the field is not sufficiently dry, it may require some attention while it passes through the sweat in the bin.

Storing. If wheat is not marketed soon after threshing, it should be stored in strong bins in a well-ventilated and mouse-proof granary. In humid regions such as Ohio, wheat shrinks little, if any, during the year.

ENEMIES OF WHEAT

Insect pests. A great many insects feed upon the growing wheat plant, but only a few of them do any appreciable damage. Each of these insect pests has insect enemies by which it is in part controlled. The pests are also affected by weather conditions, some seasons being favorable, others unfavorable, for their development. As a result bad attacks do not occur every year. They are irregular. Many years may pass between severe outbreaks.

Probably the most destructive wheat pest in the north-central states is the *Hessian fly*. This is a two-winged mosquito-like insect about one-eighth of an inch long. It produces two broods in a year, one in August and September, the other in April and May. In the fall the insect lays its eggs on the lower leaves of the young wheat plant. In a short time — three to ten days — the eggs hatch and the reddish larvae crawl down the leaves, establish themselves between the leaf sheath and stem just below the ground,

FIG. 243. *A field of wheat well shocked*

FIG. 244. *Loading sheaves of wheat*

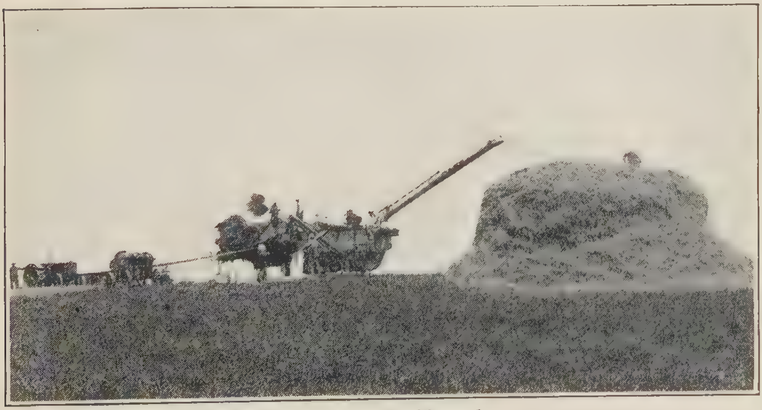


FIG. 245. *Threshing wheat*

and begin to suck juices from the plant. In a few weeks the larvae pass into the pupa or "flaxseed" stage, and in this condition they pass the winter. In the following April or May the second brood emerges. The presence of the fly is indicated by an undue yellowing of the plants in the fall, and by a noticeable breaking over of the stalks as the crop approaches maturity. The most effective method of control is to seed late, particularly if Hessian fly is known to have been present in the crop just cut.

In the drier regions of the West the *chinch bug* is a serious wheat pest, but in the more humid regions east of the Mississippi it rarely causes serious damage. In the adult form chinch bugs are small black insects with white markings on the wings. Through the winter they live under anything that will afford them protection, such as clumps of grass, weeds, stubble, and the like. Much can be done to control them by burning rubbish found in the fields and fence rows in the late fall and early spring. Though chinch bugs have wings, they travel in the summer from field to field on foot. On account of this they can often be trapped and destroyed by a strip of tar spread across their line of march.

In some sections the chinch bug causes appreciable damage to the corn as well as to the wheat crop. The injury done to the corn crop is often severe in the central western states. The chinch bug may also cause economic loss in barley.

The *wheat jointworm* is often responsible for considerable loss, but the outbreaks of this pest are rather infrequent. The *wheat midge* and *wheat plant louse* are sometimes widely prevalent, but the damage done by these insects is relatively unimportant.

Fungous diseases. The most important fungous diseases which attack wheat are (1) the smuts, (2) the rusts, (3)

anthracnose, and (4) scab. The smuts are of two kinds, (1) stinking smut or bunt, also known as covered smut, and (2) loose smut. *Stinking smut* manifests itself in the kernel only. It may not be noticed in the field, but at threshing time its presence is soon detected by the offensive odor given off by the smut balls which develop in the place of the normal kernel. *Loose smut* attacks both

FIG. 246. *Two heads of wheat at left are infected with stinking smut. Those at right are not*

FIG. 247. *This shows different stages in the development of loose smut of wheat*

the kernel and the glume. It may be noticed in the field as soon as the heads appear. As the season advances, the black spores are blown away, and in the end the rachis or central stem is the only part of the wheat head that remains.

On the average there is probably not much difference in the amount of loss caused by the two different kinds of smut. However, the loss from stinking smut is more sporadic and less uniform than is that from loose smut. Formerly the formaldehyde treatment was in common use

for the control of stinking smut, the directions for the preparation and application of the solution being the same as those given (pages 328–329) for the treatment of seed oats. However, this method has never been entirely satisfactory, for the reason that the use of it often results in a poor germination of seed. In recent years dusting the seed with powdered copper carbonate has come to be a recognized standard method for the control of this disease. In its present state of development, however, treatment by this method is somewhat more expensive than that by the formalin method, but this expense is more than compensated by the fact that the dust does not injure the germination of the seed. Best results are obtained by doing the mixing in a closed container such as a rotary drum. A more thorough mixture is effected by this plan than could be brought about by shoveling the grain spread out on a floor. Moreover, in mixing in the open, some of the dust arises and floats in the air, and this is exceedingly unpleasant to inhale. About three ounces of powder is recommended for each bushel of grain.

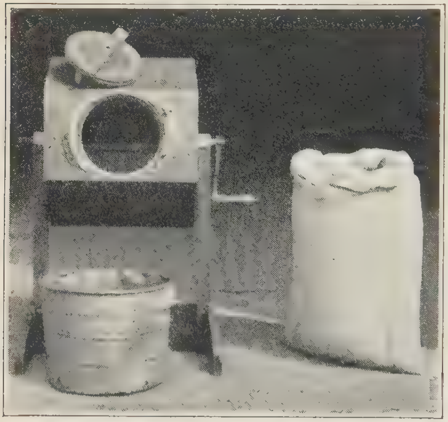


FIG. 248. *A ten-gallon rotary churn is satisfactory for treating grain with dust because it effects a thorough mixture*

The loss from attacks of loose smut rarely exceeds 2 per cent, although it may amount to 10 or more per cent. This disease may be effectively controlled by the hot-water treatment. This method, however, is rather delicate to apply and is therefore unsafe except in the hands of an

experienced operator. Varieties vary in their resistance to this disease, some being almost free from attacks of it.

The loss from *rusts* is usually not great, but it may be quite serious. There are two kinds, one of which attacks the stalks, the other the leaves. The stem rust is the more destructive.

It is well recognized that the severity of the attacks of *black stem rust* is greatest in regions where the common barberry is most plentiful, the barberry serving as a host to the rust fungus in one of its stages of development. For this reason much effort is given to the eradication of the barberry. Some varieties of wheat are more resistant than others. For example, Kanred, a variety recently developed by the Kansas Agricultural Experiment Station, is noted for its resistance to rust.

Anthracnose is a distinctly local disease which manifests itself by the appearance of minute black spots, particularly on the lower part of the stalks and leaves. It is most common where wheat is grown continuously on the same land, and under such conditions it often causes considerable loss from shriveled kernels.

Scab attacks the chaff or glumes surrounding the kernels, and its presence is indicated by the development of pink spots at the base of the glumes. Usually only a few glumes are diseased. It rarely affects the entire head. Sometimes the upper one-half of the head becomes blasted. Scab is often prevalent in wheat seeded after corn which was infested with root rot. It causes the development of shrunken kernels. The loss, however, is not great.

The severity of the attacks of all these fungous diseases, except possibly the rusts and loose smut, is reduced by growing wheat in suitable rotations. Anthracnose and scab are further checked by fanning out all the shriveled, shrunken grains and sowing only plump kernels.

QUESTIONS

1. Name the leading wheat-producing centers of the world.

2. How many types of wheat are there? Name the two types from which most of our flour is made.

3. What is the difference between white flour and graham flour? White flour and whole-wheat flour?

4. Name some of the characteristics that should be possessed by a good variety.

5. Describe one way in which new varieties are originated.

6. Can you prevent the "running out" of wheat and, if so, how?

7. Discuss the seeding of wheat as to time, quantity of seed, manner of sowing.

8. What is meant by fly-free date?

9. How would you prepare a seed bed for wheat following oats? Following potatoes?

10. What are the most destructive fungous diseases? Insect pests?

PROJECT LESSONS

Exercise I

Object. To find out the common method of growing wheat in your community.

Materials. Notebook and pencil.

Procedure. By inquiring among farmers obtain information regarding the following:

a. Number of acres sown to wheat
b. Kind of fertilizer used; quantity applied per acre
c. Name of variety sown
d. Time of seeding
e. Quantity of seed used per acre
f. Yield per acre

Conclusion. If each individual obtains the above information for one or two farms, the entire class may tabulate the results and provide some interesting information for the community on wheat culture.

Exercise II

Object. To note the characteristics of the more common varieties grown in your community.

Materials. Selection of wheat heads from various fields.

Procedure. Make a collection of wheat heads from several varieties grown in your community. Describe the heads of each variety. Are they bearded or smooth? What is the color of the chaff? Of the grain? Are the glumes smooth or velvet? Are all the heads true to type? If not, what is the percentage of mixture?

Exercise III

Object. To determine the viability of the seed.

Materials. Small box (16 inches long, 12 inches wide, and 2 inches deep), moist soil, and 100 kernels of wheat.

Procedure. Fill the box with soil and plant the seed in four rows, putting 25 seeds in each row. Place the box where the temperature is about 70° F. Moisten the soil occasionally, and in about ten days count the number of plants that have come up. The number will be the percentage of germination of your sample. If your father desires to sow his wheat at the rate of 8 pecks per acre, assuming that all will grow, then how much should he sow providing the germination is 80 per cent; 65 per cent?

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CHAPTER XXIX

SUGAR PRODUCTION

The importance of sugar. About one-eighth of the energy obtained from the food consumed by a person is said to come from sugar. The average quantity consumed, including that eaten in candy and in foods not homemade, is estimated at about a quarter of a pound per person per day. In the United States the consumption has increased in the last one hundred years from 10 pounds to about 100 pounds per person per year. The average used in cooking and on the table amounts to about 78 pounds. With the exception of England, more sugar per person is consumed in the United States than in any other country.

In the United States sugar is obtained from four principal sources: (1) sugar beets, (2) sugar cane, (3) sugar maples, and (4) honeybees.

SUGAR BEETS

Beets as a source of sugar. It was not until the middle of the eighteenth century that a German chemist discovered that beets are valuable as a source of sugar. They were first introduced into the United States in 1839, but the culture of them had not become extensive enough to warrant the erection of a factory until the year 1869, when the first one in this country was built in the state of California.

Since then the area of their culture has been much extended, but there are many sections in which the sugar content of the beets is too low to make the manufacture of sirup from them profitable. Too high temperature — 70° F. or above — is thought to be responsible for this.

The leading sugar-beet producing countries are Germany, Russia, and Czechoslovakia. In the United States the production of beet sugar has more than quadrupled in the last twenty years. The leading sugar-beet producing states are, in the order named, Colorado, Michigan, Utah, California, Nebraska, and Ohio.

The sugar-beet plant. The sugar beet is an enlarged taproot on the crown of which are borne large broad leaves.

FIG. 249. *Sugar beets*

In form the beet is not unlike an inverted cone rounded off at the base. The flesh is white, and the sugar content may vary from 5 to 20 per cent. If it falls much below 15 per cent, the culture of sugar beets is not regarded as profitable. Unlike mangel-wurzels, they grow almost entirely underground.

Growing the crop. *Seed bed.* While the adaptation of sugar beets is not extensive, this limitation is thought to

Courtesy Ohio State University, Columbus

FIG. 250. *Much hand labor is required in growing sugar beets*

be due more to the climate than to the soil. However, the beets do better on some types of soil than on others, silt and clay loams being preferable. The long roots call for relatively deep plowing. Fall plowing is desirable when it does not injure the land. Thin or poor land should be enriched by the use of well-rotted manure or a high-grade commercial fertilizer.

Courtesy Ohio State University, Columbus

FIG. 251. *Matt J. Irman, Ohio state champion sugar beet grower, 1925, who grew 20.16 tons per acre*

Culture. Sugar beets are usually planted about the same time as corn, in rows 20 to 24 inches apart, with the use of about 15 pounds of seed per acre. The so-called seed is in fact a seed ball containing

from one to five seeds. It is therefore necessary to thin the plants when they are young. The work is done carefully by hand and consists of two operations, "blocking" and "thinning." When four leaves have developed on the plants, they are "blocked" with a sharp hoe. This process leaves tufts of beets 8 or 10 inches apart in the row. Each tuft or bunch is then thinned by hand to one plant, this operation leaving the individual plants 10 or 12 inches apart in the row. This work is usually done by colonies of foreigners. The plants grow slowly at first. Therefore, in order to protect them from weeds, it is important that the early cultivations be given frequently and thoroughly. Cultivations should be continued until the plants meet in the rows.

Courtesy Ohio State University, Columbus

FIG. 252. *Cultivating sugar beets*

Harvesting. Four operations are involved in the process of harvesting: (1) lifting, (2) topping, (3) pulling, and (4) hauling. The so-called lifting is done by plowing near the rows. This plowing loosens the soil so that the beets can

easily be pulled out by hand. Topping consists of cutting off the leaves with a knife at the lowest leaf scar. The beets are then hauled or shipped to the factory where the sugar is extracted and placed on the market. The pulp or residue left after the extraction of the sugar is used for stock feed, particularly for dairy cows. During the war it was demonstrated that sugar-beet seeds could be grown

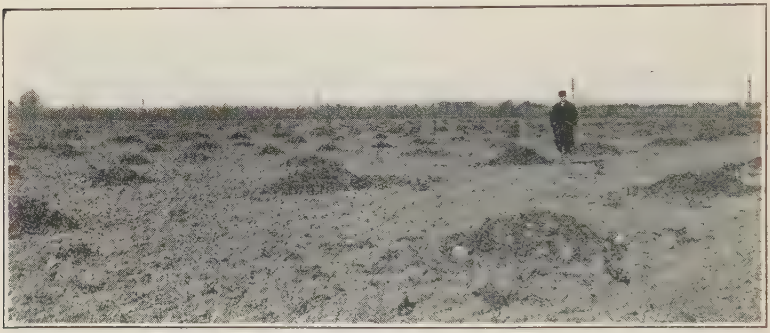

FIG. 253. *Sugar beets topped and ready to haul to market*

successfully in this country, but on account of the cheapness of foreign seed most of that now used in this country is imported.

SUGAR CANE

Importance. In 1925 there was about twenty-seven million tons of sugar produced in the world. Two-thirds of this was from sugar cane. Cuba, India, Java, South America, the Hawaiian and the Philippine islands are the most important places of production, but there is some cane grown in all moist tropical countries. An attempt is being made to grow sugar cane in the Jordan River Valley, in Palestine, by means of irrigation.

In the United States, Louisiana produces most of the commercial supply of sugar cane. The cane growers plant about 200,000 acres and harvest three million tons of cane

annually. Two hundred thousand tons of raw sugar is obtained from this crop.

Characteristics of sugar cane. Cane is a grass, growing ten or fifteen feet high. It is such a coarse, heavy grass that we seldom think of it as such, but the tassels, found in tropical countries, are much like those of grasses. There are many varieties which have been grouped into three

Courtesy International Harvester Company

FIG. 254. *Planting sugar cane*

Courtesy International Harvester Company

FIG. 255. *A small sugar-cane mill and sirup-making equipment*

large classes, (1) green, (2) red, and (3) striped, according to the colors of the blades and canes. Cane growers in Cuba have two varieties that seem to be very popular, known as Uba and Cristalina. These have been selected because they produce a high percentage of sugar and have very little fiber. Some varieties are early in maturing, while others are late. Many planters take advantage of these differences so that they may have a longer period for harvesting the crop.

FIG. 256. *Tools used for harvesting sugar cane*

Growth conditions. A long period of warm weather with plenty of water is necessary for profitable sugar-cane production. The water may be supplied by irrigation if there is not sufficient rainfall. For high production, the soil must be fertile, with an abundance of nitrogenous material from decayed vegetation. River bottoms and well-drained swampy regions meet this need. Applications of lime have been found to be advantageous in correcting the acidity of these soils.

Cultivation. The preparation of the soil is not greatly different from that for other crops. Plowing and disking destroy the weeds and provide a desirable seed bed. Listers or other two-way plows (middle-busters) are used in opening the furrows for planting. Disk plows are quite

popular because the disks are reversible and may be used for cultivation. The cane "seed" — sections of the stalks containing nodes from which buds for the young plants develop — are dropped end to end in the furrows. The width between these furrows varies from 6 to 3½ feet. The latter width has been shown to be the most desirable for high yields. Good sugar-cane land produces an abundance of big weeds, and thorough cultivation, as for corn, is advisable until the ground is shaded.

Harvesting. The time for harvesting sugar cane is different from that of other crops. The frost limitation determines it in many localities, for it is important that the work be completed before the first killing frost. Planters in warmer countries aim to harvest the cane just at the time of *greatest vegetative growth*, before it shows signs of tasseling. At that time the sugar content is highest. The practice of "stripping" the canes of leaves by hand has

FIG. 257. *Harvesting sugar cane in Cuba*

been the approved method for ages, but the larger planters haul the entire crop to the mill on trucks or cars. Where fields have been growing cane for several years, small

narrow-gauge railways are used for hauling cane. This task is not light when we consider that fifteen or twenty tons of cane is produced on an acre. Cutting is usually done by hand. Since the lower nodes contain the most sugar, it is important to cut as near the ground as possible. The upper parts of the stalk seem to contain less sugar and are often cut for "seed." Large planters have their own mills, and they aim to mill the cane as soon as possible after cutting, in order to prevent deterioration of the sugar. The best sugar cane yields from 14 to 20 per cent raw sugar, with a crude fiber weight of 8 or 10 per cent. Cane with shorter nodes yields less sugar and more fiber, so that it is desirable to select seed cuttings from large stalks with longer nodes.

Diseases. There are serious diseases of sugar cane, many of them being accompanied by rotting of the roots. Insects and worms attack the roots, and plant lice injure the leaves. Plants lacking the proper minerals have weak stalks that fall or "lodge." Lime and potash may be supplied to overcome some of these troubles. Many of the sugar-cane troubles may be avoided by the selection of stronger and more resistant varieties.

SUGAR MAPLES

Location. The production of maple sirup and maple sugar is confined to the United States and Canada. Of the maple-sugar products of the United States approximately 97 per cent are now produced in the following states: Vermont, New York, Ohio, Michigan, Pennsylvania, New Hampshire, Wisconsin, Indiana, Maine, Massachusetts, and Connecticut. The states are named in the order of their importance.

Importance. The early colonists learned from the Indians how to make maple sugar, and for many years this was the chief source of the sugar used by the early settlers. The

FIG. 258. *Where maple sugar is made*

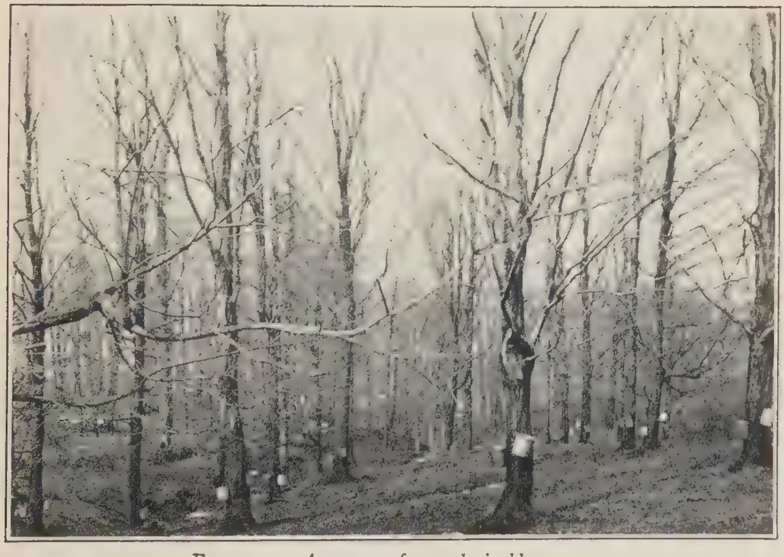

FIG. 259. *A source of very desirable sugar*

commercial importance of maple sugar and maple sirup was never great, and with the development of the sugar-cane and sugar-beet industries maple products have come to be regarded as luxuries.

The "sugar bush." The principal sugar-producing tree is the sugar or rock maple, but some sugar is made from the black and red maples. The trees in the sugar grove, or "sugar bush" as it was long called, are tapped in the spring and most of the product is made in the months of February and March. The inciting cause of the flow of sap appears to be the fluctuation of the temperature back and forth over the freezing point, 32° F. The production varies widely with individual trees and with the seasons. On the average, a tree will yield approximately 15 gallons of sap, which is equivalent to about a quarter of a gallon of sirup, or 2 pounds of sugar. The sweetness varies, but on the average the sap contains about 2 per cent of sugar. A gallon of sirup is regarded as equivalent to 8 pounds of sugar.

Perhaps 10 per cent of the crop, using the best grade of sirup, is made into "maple cream," an almost white soft creamy candy which dissolves quickly in the mouth and has a most delicious flavor.

HONEYBEES

Few are the farm boys who have not at some time or other encountered a swarm of honeybees or bumblebees. However, the honey usually obtained is regarded as sufficient compensation for the "stings."

Importance of honey. As compared with other farm enterprises, beekeeping is a relatively unimportant one. At best it is regarded as a more or less profitable side line. The total honey crop of the United States approximates 250,000,000 pounds, and is valued at approximately $75,000,000. The production in the United States now

exceeds that of other countries, California being the leading state.

Kinds of bees. The yellow Italian bee is widely distributed and is the most profitable. The German or black bee or wild bee is much less common, and is rarely found in the pure form any more. Most of the present-day hybrids are crosses between these two kinds.

In each colony or swarm there is one perfect female, the queen, which is the mother of all the rest. Besides the queen, there are the thousands of imperfectly developed females known as *workers*. These bees, as the name suggests,

a *b* *c*

Courtesy A. I. Root Company, Medina, Ohio

FIG. 260. *The honey bee, natural size*

a—Worker *b*—Drone *c*—Queen

are the ones which do all the work involved in running the home. They gather the nectar, make the honey, and feed the young bees. Besides the queen and workers there are male bees, or drones, that do not work. These are noisy individuals that do much buzzing, but they never sting. The queen may always be recognized by her extreme size.

Food supply. In the flowers of many plants there is secreted a sweet substance known as nectar. From this material bees make honey. The leading nectar-producing flowers visited by bees are the clovers, particularly the white, the so-called sweet clovers, catnip, cucumber, dandelion, goldenrod, buckwheat, linden or basswood, locust, and chestnut.

Sometimes it is necessary to feed bees. This is usually done either to stimulate brood-rearing at times when no flowers are available or to supplement a low food supply at the approach of winter. Honey or granulated sugar may be used.

Foul brood. One of the worst enemies with which the beekeeper has to deal is foul brood. More injury results from this disease than from extremely cold weather. It is a bacterial disease which attacks the larvae, or young bees, before they emerge from the cells. It causes decay of the cells, and this is accompanied by a characteristic foul odor — hence the name foul brood. The bacteria cling to the feet of the bees, and in that way they are carried not only to all parts of the hive, but also to the blossoms which the bees visit in their search for honey. Other bees from normal hives working on the same blossoms become infected and carry the disease home. Thus the disease may be spread from one colony to another. Formerly destruction of the hive was the only remedy by which to prevent the spread of the disease. Later discovery has shown that it can be controlled with a formalin-alcohol solution.

Courtesy A. I. Root Company, Medina, Ohio

FIG. 261. *Near view of a beehive*

QUESTIONS

1. About what is the yearly consumption of sugar per person per year in the United States?

2. Mention the four important sources of sugar.

3. From what source do we obtain most sugar?
4. In what two countries is maple sugar produced?
5. Name five of the leading sugar-producing states in the United States.
6. From what kind of tree is sugar usually made?
7. About how much will one tree, on the average, produce?
8. Name the two leading kinds of honeybees.
9. Name the three classes of bees found in a colony.
10. What is the most destructive enemy of bees?

PROJECT LESSONS

Exercise I

Object. To find out the common method of growing sugar beets in your community.

Materials. Notebook and pencil.

Procedure. Consult a few farmers regarding the following:

a. Number of acres planted to sugar beets
b. Time of plowing: fall or spring
c. Kind and quantity of fertilizer used
d. Time of planting
e. Quantity of seed used per acre
f. Distance between plants after thinning
g. Usual number of cultivations given
h. Yield
i. Sugar content of beets. How much does it vary from year to year?

Conclusion. If each individual obtains the above information for one or more farms, the entire class may tabulate the results and provide some valuable information for the neighborhood on the culture of sugar beets.

Exercise II

Object. To determine the number of barrels of sap required to make a gallon of sirup, the standard weight of sirup being 11 pounds per gallon.

Materials. A maple sugar bush.

Procedure. Note the number of barrels of sap obtained at one "gathering." Note also the number of gallons of sirup produced after the sap is "boiled down." From these two figures calculate the number of barrels of sap required to yield one gallon of sirup.

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Transferring Bees to Modern Hives. Farmers' Bulletin 961.
The Treatment of Bee Diseases. Farmers' Bulletin 442.

CHAPTER XXX

FRUIT GROWING

In pioneer days fruit was regarded largely as a luxury. Its value in the diet was not well recognized. Little attention was given to its production. The art of spraying was unknown. Instead of being marketed, surplus fruit was often fed to live stock or allowed to go to waste on the ground.

Today fruit is regarded as an essential part of a well-balanced ration. Food authorities are constantly recommending a more extensive use of it, because the eating of fruit is conducive to good health. Some fruits even prevent certain diseases. For example, it is well known that orange juice prevents scurvy in infants. This is because the juice contains the recently discovered principle known as vitamin C. Moreover, what is more appetizing than a variety of well-selected fruits? Who does not enjoy a good strawberry shortcake, fresh peaches and cream, or a plate of luscious apples?

The family and the commercial orchard. The culture of fruit has progressed in two directions: (1) the home orchard and (2) the commercial orchard. The chief advantage of a small, well-planned home orchard is that it may furnish a continuous supply of fresh fruit. Any surplus can be sold through roadside markets which are made possible by modern roads and automobiles. Without a good home orchard a family is often deprived of an adequate supply of good fruit.

The chief disadvantage of a home orchard is that it requires attention when the rush of general farm work is most pressing. Unless sprayings are made at the proper

time, much of the fruit will be wormy and of inferior quality. Some machinery in addition to the general farm equipment is needed. As a result, many home orchards are sadly neglected, and an increasing number of families are coming to depend on commercial orchards for their supply of fruit. Commercial orcharding is a highly specialized industry and one that has been developed largely within the last fifty years.

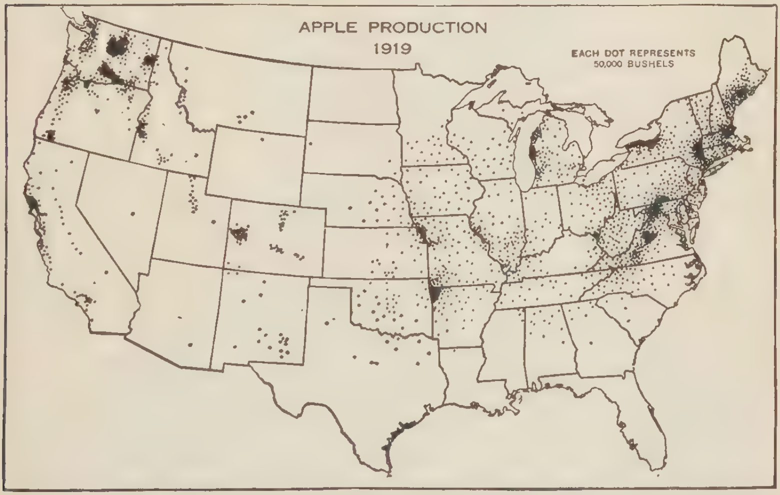
Besides apple, cherry, peach, plum, and pear trees, the home orchard should also contain such small fruits as strawberries, raspberries, blackberries, gooseberries, currants, and grapes. Such an orchard should contain a few apple trees of different varieties, so selected as to furnish a succession of fruit throughout the season. In a commercial orchard, on the contrary, the number of varieties is usually restricted to a few standard sorts. Whether fruit is grown in a family or in a commercial orchard, the methods of culture are the same.

Location of an orchard. There are few if any farms on which fruit will not grow well enough to supply the home needs. However, the requirements of all kinds of fruit are not alike. The growing of any particular kind in a commercial way should not be undertaken except in those parts of the country where the soil and climatic conditions are most favorable. Apples, for example, are grown more extensively than any other fruit, but they are not adapted to all parts of the country. The distribution of their production in the United States in 1919 is shown in Figure 262.

A fertile, well-drained soil is preferable, and the site chosen should be elevated above the surrounding country so that the cold air may drain away into the lower territory and thus lessen the chances of injury from frosts in the late spring and early fall. In some regions and for

certain kinds of fruit the slope of the ground should be given consideration, as it has a bearing on protection against frost and on the coloring of the fruit.

Classification of fruits. Deciduous fruits may be divided into three general groups: (1) pome fruits, or those fruits which have a core containing a number of seeds, such as apples and pears; (2) stone fruits, which contain a single



Courtesy United States Department of Agriculture, *Yearbook*, 1921

FIG. 262. *Apple production in the United States*

seed or stone, as peaches, plums, and cherries; and (3) small fruits, which include the berries, grapes, and currants.

Propagation of fruits. Nearly all the good varieties of fruit have originated by accident. For example, the splendid apple known as McIntosh was found among a clump of seedling apple trees in a forest in Canada. Mr. McIntosh, the man who discovered the tree, noticed that the quality was very fine and decided to give the variety his own name, and he then grafted some wood from this tree on other trees. In this way the variety was first

propagated, and for more than a century it has been perpetuated either by budding or by grafting.

In most cases seeds will not produce plants that bear fruit exactly like that of the parent plant or tree. Therefore, in order to reproduce fruit, we use one of the following methods: grafting, budding, cuttings, or sucker plants.

Grafting and budding are very similar. In either case wood growth made in the previous season is removed from the tree or plant and inserted in the stock which is to be used for the new tree or plant. In the case of grafting, a piece of wood containing several buds is used, while in budding, only one bud is used. Cuttings consist of parts taken from the growth made in a single season. Propagating by such plants consists in selecting and setting the small plants that originate near the base of the older plant. All tree fruits are either budded or grafted. Grapes, currants, and gooseberries are propagated by cuttings, while berries are reproduced chiefly from sucker plants.

Culture of fruit trees. *Tillage.* Trees are grown successfully under two types of cultivation: (1) tillage and (2) grass mulch.

Probably the system most extensively used is tillage. Under this system the ground is kept cultivated through the early part of the growing season and then, in midsummer, either a cover crop is sown or weeds are allowed to grow.

The purposes of a cover crop in an orchard are to keep the ground from washing during the winter and to add vegetable matter to the soil. Soy beans, cowpeas, rye, oats, buckwheat, vetch, wheat, and crimson clover are some of the important cover crops used in orchards.

Grass mulch. Under the grass mulch system, the orchard is kept in sod and the grass is mowed one or more times each season. The grass is either left on the ground where

it falls or raked up and placed about the trees as a mulch. The advantage of this system is that it can be used on hilly land where washing of the soil prevents the use of tillage. It usually costs less than tillage and provides better working conditions in the orchard. Fertilizers are nearly always required where this system of orchard culture is practiced.

Pome fruits can be grown successfully under either system of orchard culture, but stone and small fruits usually do better under tillage.

TREE FRUITS

Apples. *Planting an apple orchard.* In the planting of an orchard we speak of trees as either permanent or fillers. Permanent trees are those which it is intended shall

FIG. 263. *The Delicious apple. An apple orchard ten years old. A soy-bean cover crop is grown on the left and a grass mulch on the right*

remain in the orchard permanently. Apple trees are long lived, and are therefore usually set as permanent trees. They are generally planted not closer than 40 feet apart. Filler trees are planted between the permanent trees

and should be varieties which do not grow rapidly, but bear early, and which have an upright form of growth. Filler trees are usually removed in fifteen to twenty years after planting. Peach trees are quite often used as fillers in an apple orchard.

Apple trees can be planted either in late fall or in early spring. Trees that have been grown either one or two years in the nursery from the time they were budded or grafted are the best for planting.

The hole in which the tree is set should be large enough so that the little roots will not be crowded. The tree should be set an inch or two deeper than it was in the nursery and the soil should be firmly placed about the tree.

FIG. 264. *Pruning tools*

Apple varieties. There are several hundred varieties of apples grown in the United States, but the most important varieties named in the order in which they ripen are: Yellow Transparent, Early Harvest, Red Astrachan, Duchess of Oldenburg, Golden Sweet, Benoni, Jefferies, Lowell, Chenango Strawberry, Maiden Blush, Wealthy, Wilson Red June, Gravenstein, Summer Rambo, Mother, McIntosh, Grimes Golden, Rhode Island Greening, Jonathan, Northern Spy, Delicious, Winter Banana, Baldwin, Golden Delicious, Rome Beauty, Yellow Bellflower, Paradise Sweet, Stayman Winesap, Ben Davis, and Winesap.

Pruning apples. Sunlight is essential to make apples color and develop good quality. In order that the right

amount of sunlight may reach into the center of the tree, and also to make efficient spraying possible, apple trees should be pruned each season. It is best to do pruning

FIG. 265. *A school exhibit of apples*

while the trees are dormant, because it is easier to see the limbs and twigs which should be removed when there are no leaves on the tree.

Diseases and insects. A number of diseases and insects injure apples. Some of the diseases are blight, apple scab, blotch, and bitter rot. Codling worms, curculio, scale, and plant lice are the most injurious insect pests. Many of these diseases and insects are controlled by spraying or dusting. Spraying is more commonly done than dusting, and, in spraying, certain chemicals, such as sulphur, lime, blue vitriol, arsenate, and nicotine, are mixed with water and sprayed on the trees with a pump. Farmers having large orchards have power sprayers operated by gasoline engines, while farmers having small orchards usually have

FIG. 266. *Spraying a mature orchard*

FIG. 267. *Apples packed in barrels. Those on the left are from the fertilized row and those on the right are from the unfertilized*

spray pumps operated by hand. It is necessary to spray five or six times to get the best fruit.

In dusting, the chemicals are applied dry with power dusting machines. The dusting method to control diseases and insects on fruit trees has not been so fully tested as spraying.

Pears. While pears do not grow so well in America as in Europe, there are a few pear trees on most farms, and in certain sections large quantities of pears are grown. California, Oregon, Washington, Michigan, and New York are states which produce pears in large quantities. Twig blight is very serious on pears, making it difficult to grow them in many places. The best varieties of pears are Bartlett, Seckel, Anjou, Clapp, Duchess, Flemish Beauty, Bosc, Sheldon, and Kieffer.

The culture and the spraying treatment for pears are similar to those given apples.

Quinces. The quince tree never develops to a large size, and is quite often called a bush. This is a very old fruit, but it is the least important of all the tree fruits. Plantings of quinces are generally confined to a few trees or bushes. Quinces grow best in moist soils. The blight which affects pears is even worse on quinces. The chief varieties of quinces are Champion, Orange, and Rea.

Peaches. The peach is second in importance to the apple, and most species of it are native to China and Persia.

Peaches can be grown only in sections of the country where the temperature does not as a rule drop more than 15°F. below zero. Commercially peach growing is not safe where the temperature frequently falls below freezing after the blooming period. Often peach orchards are located near large bodies of water, as for instance the Great Lakes, because such lakes tend to equalize the temperature for several miles inland.

There are more than two hundred varieties of peaches listed in the catalogs of American nurserymen, but less than twenty of them are of recognized value. Some of the better varieties of peaches are Carman, Champion, Early Elberta, Wilma, Lemon Free, Elberta, Smock, Salwey, and Rochester.

Peaches thrive best in sandy soils. They should be planted in the early spring and are usually spaced about 20 feet apart each way. The little tree is cut off 20 to 24 inches from the ground in order to form the head of the tree near the ground. The same care used in preparing the hole and setting the tree in the case of the apple should be exercised in setting the peach.

The objects of pruning the peach tree are (1) to form the head of the tree so that it will be near the ground and in such a manner that it will have strength to withstand the wind and carry heavy loads of fruit, and (2) to permit the sunlight to reach the center of the tree.

Peach trees require heavier pruning than apples, and are also trained to a different form or type from an apple tree. At the beginning of the second year the farmer forms the permanent head of the tree by selecting four or five side branches for main branches, and then removing the main center branch three or four feet from the ground, thus forming a low-headed vase-shaped tree.

The extent of pruning is regulated by the vigor of the trees. Very vigorous trees should have about half of the growth made each season removed the following spring. Peaches are perpetuated by budding, and this is done in the late summer.

Peaches require regular treatment either by spraying or by dusting to control diseases and insect pests. The most serious disease affecting peach trees is leaf curl. It causes the leaves to curl up, turn yellow, and finally to drop off.

This disease is sometimes very serious. It is controlled by spraying with lime-sulphur solution while the trees are dormant. This same spray also controls San Jose scale, which is one of the insect pests which attack peaches.

FIG. 268. *An orchard sprayed with lime-sulphur for the control of peach-leaf curl. Result: no disease and a good crop of fruit*

Peach borers attack the tree near the base. They may be controlled either by being dug out by hand or by the application of a special gas.

The most serious insect pest that attacks peaches is the curculio. This is the insect which is commonly called the peach worm, and is frequently found in unsprayed peaches. This insect is controlled by spraying with arsenate of lead, a poison spray, just after the husks drop from the newly formed peaches.

The sprays used on apples during the summer time or after the leaves are on the trees cannot be used on peaches, because they will injure the foliage of peach trees.

Plums. Plums thrive best in sections of the country where peaches grow successfully, although certain kinds of plums can be grown in colder climates than those suitable for peaches, and even in regions where it is too cold for apples.

There are a number of different species of plums, but the most important are the European, American, and Japanese. Most of the varieties found in the farm orchards are those native to Europe. These varieties are the best for canning. Some of the better varieties of European plums are Clyman, Bradshaw, Arch Duke, German Prune,

Green Gage, Gueii, Arctic, and Shropshire Damson. The Wild Goose, the most common variety of native American plum, is good to eat raw only. A few Japanese plums are grown in this country. The chief varieties are Burbank and Abundance. These plums are of less value than are the European varieties.

The culture and care of plum trees is the same as for peaches.

Prunes. There are a number of varieties of European plums which are very sweet and rather oblong in shape. This type of plum is called a prune. Prunes are excellent for canning, but are more often dried. Italian, German, Tragedy, Giant, Agen, Sugar, and Tennant are good varieties of prunes.

Apricots. The apricot is a fruit which resembles both the peach and plum, but because it blooms so early the blossoms freeze in nearly every section of the country except in California. Its culture is confined almost entirely to that state.

Nectarines. The nectarine is identical with the peach, except that it is smooth skinned. While the fruit is of high quality, it is too soft for shipment and is subject to injury by curculio. It is not grown very much outside the state of California.

Cherries. Cherries are more immune from diseases and insects than almost any other fruit, and are grown quite generally throughout the United States. Most of our cultivated varieties originated in Europe.

The culture and management of cherry trees is the same as that of peach trees.

The better varieties of sweet cherries are Black Tartarian, Napoleon, Windsor, Lambert, Bing, and Schmidt. The best varieties of sour cherries are Early Richmond, Dyehouse, and Montmorency.

SMALL FRUITS

Grapes. Next to the apple and peach, the grape is the most important fruit of the temperate zone. There are a great many types of grapes, some having originated in America and some in Europe.

Grapes come into bearing two years after planting, and the fruit can be used for many purposes. Before the manufacture of wine was prohibited, much of the grape crop was used in making wine. Grapes are now used for eating fresh, and to make grape juice, jelly, and jams. Certain kinds of grapes grown in California are used for raisins.

Grapes, growing on vines rather than on trees, are trained on wire or wood trellises, and sometimes on the sides of buildings. The vines make abundant growth each year and require heavy pruning annually. In order to be kept free from diseases and insects they need to be sprayed, but not so often as apples or peaches.

Concord, Delaware, Niagara, Wordenk, Brighton, and Catawba are the best varieties.

Gooseberries and currants. Gooseberries and currants are very much alike in their habit of growth, and are used in much the same manner. They are too acid to be eaten in the raw state, and are used in jellies, jams, and pies. Currants and gooseberries grow on bushes four to five feet high. Gooseberries are very thorny, and for this reason are more difficult to pick than currants and consequently are not grown so extensively as currants.

Wilder and Perfection are the best currants. Houghton and Downing are the best gooseberries.

Strawberries. Strawberries are the most important of all the small fruits. They are very highly prized when eaten fresh or cooked, and can be grown in almost all sections of the United States. Because they are so well adapted to all sections of the country and can be shipped

readily in refrigerator cars, this wonderful fruit can be bought in cities for several months during the spring and early summer. Moreover, a strain of autumn strawberries has been developed.

Strawberries grow on vines which trail along the ground. Straw is used to mulch the plants, to prevent the ground from freezing and thawing suddenly, and to keep fruit clean.

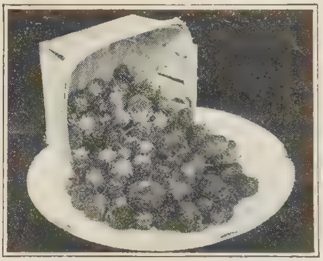


FIG. 269. *Strawberries can be grown in nearly every part of the United States*

Aroma, Brandywine, Premier, Senator Dunlap, Klondike, Gibson, Sample, William Belt, and Warfield are good varieties of strawberries.

Blackberries. Most blackberries are native to America, but a few kinds have come from Asia and Europe. Blackberries grow wild in pasture fields and along fence rows. Farmers frequently consider them weeds. The good cultivated varieties, however, are quite profitable, and are in great demand for table use, pies, jams, and jellies. Eldorado, Snyder, and Early Harvest are good varieties.

Raspberries. Raspberries are used for the same purposes as blackberries and usually sell for higher prices. Two of the most common kinds of raspberries are the red and black. Red raspberries have fewer seeds than black raspberries, and the canes on which they are borne grow in a different manner and are different in color. Red raspberry canes are reddish brown in color and grow from shoots which come from near the base of the older canes. Black raspberry canes are bluish gray in color, and the new canes come up from where the tips of the old canes take root in the ground.

Because of diseases which cannot be controlled by spraying, raspberries are more difficult to grow than blackberries.

Cuthbert is the best red raspberry, and Gregg is the best black raspberry.

Dewberries. Dewberries are like blackberries in quality, but instead of the plants being erect in habit of growth they vine along the ground. In some places they are trained up like grapes. Lucretia is the best variety.

Blueberries. Blueberries are not generally grown because they require a peculiar kind of soil. The soil must be acid and have in it certain kinds of fungi to make possible the growth of the plants. The fruit is small and tedious to pick, but is highly prized for pies and commands very high prices. There are a few cultivated patches of blueberries in the country, but most of them grow wild in fields. The New England states, Pennsylvania, and a few of the northern states and Canada grow most of the blueberries.

Cranberries. Cranberries are an important commercial crop, but, like blueberries, they require a special kind of soil—peat or swamp—and are grown only in a few favored sections. The important plantings are in Wisconsin, New Jersey, Massachusetts, Oregon, Washington, and Nova Scotia.

QUESTIONS

1. Discuss the advantages and disadvantages of the home orchard.
2. What constitutes a good site for an orchard?
3. Name the three general groups of fruit.
4. How is fruit propagated?
5. Name two methods of fruit culture and discuss each.
6. Discuss the growing of apples.
7. What varieties would you suggest for a home orchard?
8. In what respect would your choice of varieties for a home orchard and a commercial orchard differ?
9. Discuss the culture of peaches.
10. Name the important tree fruits.
11. What are the leading small fruits?

PROJECT LESSONS

Exercise I

With the aid of your county agricultural agent arrange for a grafting demonstration.

Exercise II

Make a list of the varieties of apples contained in your home orchard or in that of a neighbor.

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CHAPTER XXXI

PASTURES

IMPORTANCE OF PASTURES

Definition. A tract of land used for the grazing of farm animals is called a pasture. On such a piece of ground there may be a great variety of growing plants, grasses, and legumes, but if the plants are eaten off by live stock it is known as a pasture.

Advantages of a pasture. A good pasture is desirable because (1) it furnishes a large quantity of succulent, palatable, and nutritious feed; (2) it utilizes to good advantage rough, hilly land unsuited to the production of cultivated crops; (3) it furnishes an ideal place for the development of strong healthy animals—an abundance of fresh air, sunshine, shade, good drinking water, and a place in which to exercise; and (4) it makes possible the caring for large numbers of animals and thus effects economy in production.

Economy of a pasture. About one-half of the feed required by all the live stock in the United States is furnished by pasturage, and it is said to cost less than one-fourth as much as would the same quantity of harvested feed. The cheapness of pasture is due to: (1) the low cost of production—about four-fifths of our pastures are native grasses—and (2) the cafeteria style of harvesting. The cheaper the cost of the feed, the less, of course, will be the cost of all our meat, dairy, and wool products.

Essentials of a good pasture. The most important factors to be considered in a satisfactory pasture are (1) location, (2) water supply, and (3) shade. Pastures that are located in close proximity to the buildings are more

convenient than are those separated from the barn and reached, therefore, by a long narrow lane. If possible, the barnyard should open directly into the pasture fields. Otherwise much valuable time is consumed in going up and down the lane after cows and workhorses. Unfortunately not all pastures can be so arranged, because the location of them is determined by the countour of the land. However, where land is plentiful and not all of it is needed for farming, it is desirable to select that near the barn for pasture purposes.

An indispensable part of a good pasture is an abundant supply of pure cold water. Good water for cattle is as essential to the general health of boys and girls as to that of the animals, because the former are dependent on animals for much of the food they eat. Some diseases are traceable to unhealthy animals. A field in which there is no pond or through which a stream or spring does not flow is not well suited to pasturing. In such cases a well must be dug. Warm, stagnant, impure water is not conducive either to good health or to maximum milk production.

No pasture is ideal in which there are not a few good shade trees. In the hot, dry weather of summer when the flies are bad, a little shade adds greatly to the comfort and general welfare of the animals. Often a part of the pasture field is woodland, in which case the woods not only furnish an abundance of shade, but offer protection in time of storm. However, foresters do not recommend the pasturing of woodland, chiefly because the animals prevent the starting of young trees. Moreover, the value of the forage obtained by the stock is not great, because the stand of grass in the woods is always thin, and the quality of the forage is inferior to that grown in the open.

Productiveness of pasture. The amount of feed or pasturage produced per acre varies with the fertility of the soil,

FIG. 270. *A pasture near the barn is convenient*

FIG. 271. *Shaded pastures are desirable*

and is expressed as the "carrying capacity" of a pasture. In a very good pasture an acre has a carrying capacity of, or will maintain, one cow for six months. In the better pastures of the blue-grass region from two to three acres are required to sustain an animal for one-half the year. In poor, thin pastures or on range pastures as many as ten acres of land may be required to keep an animal.

Kinds of pasture. There are two classes of pasture — permanent and temporary. Permanent pastures are tracts devoted continuously to grazing, and usually occupy

FIG. 272. *A rolling and shaded pasture is enjoyed by beef cattle*

uneven land on which the use of farm machinery is impracticable, or at least is attended with difficulty. They constitute about 80 per cent of the total pastures in the United States.

Temporary pastures are tracts used for grazing for two or three years only. Sometimes an emergency arises in which extra pasture is needed for one season or perhaps for two or three months only. In such cases some of the cereals are usually sown, thus making what are sometimes called supplementary pastures.

PERMANENT PASTURES

Native grasses. Most permanent pastures consist of a mixture of native plants. The mixtures are not alike in all parts of the country. It is fortunate that the species of plants are numerous, and that their requirements are diversified, because, as a result, some of them can grow in all parts of the world, from the tropics to the poles. In the

United States, outside the Great Plains region, the backbone of the permanent pastures is Kentucky blue grass in the North and Bermuda grass in the South, the latter being confined largely to the Cotton Belt.

Blue grass a good fighter. Without doubt most of the bluegrass pastures are natural. The grass has simply spread and taken possession of the land without man's help. On limestone soils located in the humid regions Kentucky blue grass is almost invincible. So persistent is this grass that many farmers regard it as the most serious pest with which they have to contend in the growing of alfalfa. The grass is at its best in Kentucky and in the group of states adjoining.

Man-made pastures. Sometimes it is desirable to reëstablish a permanent pasture on land that is under cultivation. Where cultivated crops such as corn or potatoes are grown on hilly land, it is likely to wash, forming deep ditches and gullies. Such land should be seeded down and used as a pasture or meadow. More and better pasturage will be obtained by sowing a mixture of seeds than by sowing any one kind. Some plants develop slowly, others grow rapidly. Some are deep rooted, others are shallow. Some start early in the spring, others start late. Some grow fairly well during hot, dry weather, others furnish little or no forage in dry spells.

Mixture of seeds. For use in the northern states, a mixture such as the following is suggested:

Kentucky blue grass	10 pounds
Timothy	6 pounds
Red top	5 pounds
Orchard grass	4 pounds
Red clover	2 pounds
Alsike clover	2 pounds
White clover	2 pounds

In a short time the blue grass and white clover will occupy the field, but in the first few years, while they are getting well established, the other grasses and clovers will furnish good feed.

The mixture may be altered, to suit special conditions. In selecting the grasses to be used, it is well to note whether the proposed grasses run wild in the region to be seeded. Any grass not growing naturally can hardly be expected to

FIG. 273. *White clover in a pasture improves the quality of the forage; it also enriches the soil and thus promotes the growth of the pasture grasses*

be successful in a permanent pasture. Timothy is more useful as a meadow grass than it is in pastures, but it is usually included in pasture mixtures because it grows rapidly and furnishes feed while the other grasses are establishing themselves.

Red top. One of the most useful grasses to sow on low, wet ground or on that in which the lime content is too low for blue grass to flourish is red top. It has a creeping rootstock and for that reason is valuable to sow in places subject to washing. In midsummer, when the head or

panicle is fully developed, it takes on a reddish-purple color, hence the name "red top."

Orchard grass. This grass is often included in pasture mixtures because (1) it is the first grass to start in the spring, (2) it grows late in the fall, (3) it continues to grow in hot, dry weather, (4) it recovers quickly after cutting, and (5) it will endure a considerable amount of shade. Because it is somewhat tolerant of shade it is frequently seeded in orchards, hence the name orchard grass. Unlike red top and blue grass, it does not spread by rootstocks. It grows in tufts. This is a disadvantage, because it does not form an even sod.

Canada blue grass. On land too poor and too dry for Kentucky blue grass to flourish, Canada blue grass is often sown. It is less productive than Kentucky blue grass, but the forage is highly nutritious. The seeds are often used as an adulterant of Kentucky blue grass.

Brome grass. In regions where Kentucky blue grass and timothy are well adapted, brome grass is of secondary importance. This grass is most useful in the semiarid regions of the Northwest.

Pasture in rotations. Sometimes pasture is included as one of the crops in a regular rotation. Usually the field is mowed one year as a meadow and then grazed one or two years before plowing. In such cases, the seed mixture is sown in a small-grain crop such as oats or wheat.

Clipping pastures. After many years of grazing, pasture land, like all other kinds of land, becomes poor and unproductive. Blue grass gives way to other grasses and weeds, such as Canada blue grass, yarrow, ragweeds, daisies, ironweeds, thistles, etc. The weeds are unpalatable and are not relished by farm animals. Clipping will do much to rid pastures of these pests. If the field is fairly level, the work can be done with a mowing machine. Otherwise a

bush hook or mattock may have to be used. Many weeds may be killed by pasturing with sheep or goats.

Renewing pastures. Recent experiments have shown that on old and rundown pastures a new sward consisting chiefly of blue grass and white clover can be restored by the application of limestone and acid phosphate. In few

FIG. 274. *Fertilizing a pasture*

cases are plowing and reseeding necessary. Barnyard manure will do much to revive worn-out pastures, but it renders the grass unpalatable for a time.

TEMPORARY PASTURES

Often extra pasture is needed for a few months or perhaps a few seasons. Crops sown primarily for other purposes can occasionally be used to meet this demand. Old meadows sometimes furnish much valuable pasture. Red and alsike clovers are relished by all kinds of live stock. The alsike is more inclined than the red to be a perennial, and for that reason is better suited than the red for long-continued pasturing. Wheat is sometimes pastured in the fall and to a limited extent in the spring, but the practice is precarious, for it sometimes injures the wheat. If special seedings are to be made, the kind of seeds used will depend largely on the kind of animals for which pasture is needed.

Cow pasture. Winter rye or a mixture of rye and vetch, sown in early fall, will make good pasture late in the fall and early in the spring. A mixture of oats, barley, and rye, sown in the spring at the rate of one bushel per acre of each kind of seed, makes satisfactory pasture in early summer and fall.

Soy beans, drilled at the rate of 1½ to 2 bushels per acre, will furnish good pasture in the fall. In a favorable season sweet clover sown in the spring can be expected to furnish some late pasture. Sudan grass, sown after warm weather is assured, makes rapid growth and furnishes an abundance of forage in July and August.

Hog pasture. As a temporary pasture for hogs perhaps nothing is more satisfactory than rape. It is a cool-weather plant and is quite resistant to drouth. Rape is a close relative of the cabbage and turnip. It develops large, fleshy, succulent leaves and stems which are greatly relished, not only by hogs, but by sheep and poultry as well.

Rape can be sown as early in the spring as oats, and under favorable conditions is ready to pasture in six to ten weeks after seeding. It will continue to furnish pasture until frosted in the fall. Rape may be sown broadcast, at the rate of 4 to 5 pounds of seed per acre, or it may be sown in rows 24 to 30 inches apart, at the rate of 2 or 3 pounds of seed per acre. Seeding in rows is preferable because it permits cultivation, and this hastens the early growth. Moreover, the space between the rows provides a place for the animals to walk, and thus avoids injury to the plants by trampling.

Rape may be sown in corn at the time of last cultivation and pastured as the corn is "hogged down."

Alfalfa, sweet clover, and soy beans each make good late fall pasture. The alfalfa and sweet clover may be seeded in the spring in wheat or oats as a nurse crop.

QUESTIONS

1. Mention four advantages of pastures.
2. What are three important qualifications of a good pasture?
3. How does a permanent pasture differ from a temporary pasture?
4. What is the most common "native" grass of the Corn Belt?
5. Name four other kinds of grass adapted for pasturing.
6. How may old pastures be renewed?
7. In what way should a hog pasture differ from a pasture for cattle?

PROJECT LESSON

Exercise I

Object. To find out the kind and quality of pastures in your community.

Materials. Pencil and paper.

Procedure. By inquiry among farmers find out the following things:

a. Kinds of temporary and permanent pastures maintained
b. Area devoted to pastures
c. Number of acres required for individuals of the various kinds of live stock
d. The number of months that pastures may be used during the year
e. Kinds of fencing used
f. The cost of pasturing animals

Conclusions. If each individual obtains the above information for one or two farms, the entire class may tabulate the results and provide some interesting information for the community.

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CHAPTER XXXII

RICE

Importance. Seven hundred million people in the world depend upon rice for their cereal food. Most of them do not live in the United States, and we are inclined to regard the cultivation of rice as of little importance. When you consider that there are about as many people who eat rice for their daily food as there are people who eat all other kinds of grain, it is well to give some attention to this great world crop. Only about four hundred million people use wheat for making bread. International agricultural reports show that about three billion bushels of rice is grown each year, while only about two billion bushels of wheat is produced.

History. Almost three thousand years before Christ the emperor of China issued an imperial edict requiring all Chinese farmers to grow five kinds of food plants in their gardens. He insisted that they pay especial attention to irrigating, planting, and harvesting their rice crop. The Pyramids were probably still new in Egypt in those days, and it was more than four thousand years before Columbus discovered America. Rice is still the principal grain crop of the Orient, and it is cultivated in much the same manner as it was a thousand years ago. The people of India may have begun to raise rice about the time the Chinese did. Italian and Spanish travelers introduced the crop into southern Europe shortly before Columbus sailed for America. Rice was brought to Charleston, South Carolina, in 1694. The seed was planted in a garden. It grew so well that the crop became very popular along the swampy coast of the southeastern states.

FIG. 275. *A progressive farmer in Japan threshes rice with this remarkable invention. Everybody works*

Where rice grows. Louisiana, California, Arkansas, southeastern Texas, and South Carolina produce nearly all of the American crop. The acreage is very small when compared with that sown to wheat or corn. Since so many people in Asia eat rice, one might ask why Americans do not grow a larger crop. We produce only a few thousand bushels of the great world crop. The reason for our not growing so much rice may be explained by the fact that our ancestors did not raise it, and we find it more profitable to grow wheat and corn.

Varieties. The Japanese seem to have about fifty-four varieties of rice. These are adapted to almost every condition of moisture and climate, from the cold northern portions of their islands to the warm, moist southern portions. However, rice thrives best in swampy regions or where an abundance of water is supplied during the

FIG. 276. *A Japanese farmer taking his bundles of rice from the field. He is walking along the embankment between paddies. Note the elevated pipe line of bamboo, for irrigating*

FIG. 277. *A modern Oriental rice mill; the hulls are being removed*

growing season. Dry-land rice requires less attention, but it does not yield well. Japanese and Filipino farmers have lowland yields of 70 or 80 bushels per acre. Thirty-eight bushels seem to be an average American yield, according to the United States Department of Agriculture *Yearbook*. The "Honduras" and "Japan" varieties are favorites in America.

Cultivation. Orientals have methods of cultivating rice that would hardly be applicable to our American conditions. Their success in growing enough to feed so many millions of people is surprising. Intensive cultivation is probably the secret of their success. They plant a small plot some fifteen or twenty feet square with perhaps a bushel of rice. The bed is flooded until the plants have grown to a height of six or eight inches. These are pulled by hand and transplanted to a "rice paddy." The latter is made by throwing up a mud wall ten or twelve inches high about a level tract approximately an acre in extent. The paddy field is flooded by irrigation or by rains. The mud walls will last for years with slight repairs. Before transplanting, a slushy, muddy seed bed is prepared. The Filipinos use carabao (water buffalo) to tramp the paddies and to insure the right degree of slime and mud. Planters wade through the mud, half knee-deep, and place the seedlings in the mud to a depth of three or four inches. The average farmer plants about two or three acres during the season. Since Oriental families are often large, a greater acreage is possible.

The American method of growing rice is not greatly different from that of growing wheat or oats. The soil is plowed and harrowed to form a good seed bed. Seed is drilled at the rate of two bushels per acre. This work is done while the fields are dry. After the rice has grown to a height of six or eight inches, the fields are flooded to a depth of five inches. Flooding insures an optimum amount of moisture and prevents the growth of weeds. It may be

Courtesy International Harvester Company

FIG. 278. *Plowing rice land. The tractor wheels have extensions to prevent sinking into the wet earth*

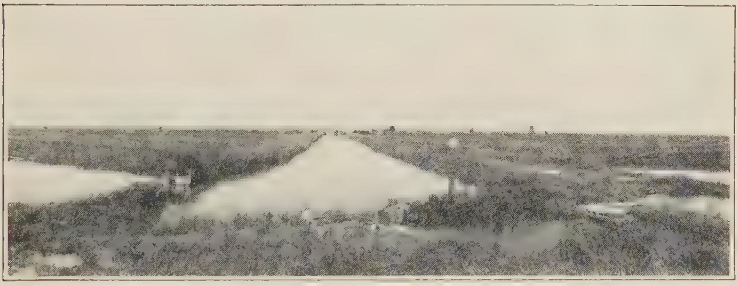

FIG. 279. *Irrigating a rice field* (*Louisiana*)

Courtesy International Harvester Company

FIG. 280. *Threshing rice in the modern way*

noted that this practice is followed only in swampy or irrigated regions where the land is level. April planting produces the largest yield. Water grasses and cat-tails are the most common enemies of lowland rice.

Harvesting. Binders have taken the place of the laborious methods of cutting rice with a small sickle. Broad-wheeled tractors will pull them through fields where the ground is too soft for horses to walk. Combination harvesters have been used to an advantage in irrigated fields. The fields may be allowed to dry before the harvesting begins. In this manner it is possible for two or three men to produce more rice than forty or fifty Orientals. Threshing is a comparatively simple process with a modern American thresher, but it is a laborious task with the methods of Asiatics.

Milling and polishing. Rice has a seed coat of a hard, chaffy material covering the grain. A darker coating of

FIG. 281. *Harvesting rice where it would be difficult to pull the binder with horses*

protein material lying just under the outer coat is a very good food, but Americans prefer to have their rice white in color. The outer coat is removed by passing the grain through a mill containing rollers. The dark inner coat is

removed by polishing the grains with rollers covered with sheepskin. The result is that we have a clean white rice grain, without the outer coverings and with the germinating part of the seed removed. It is nearly all starch, as

FIG. 282. *The largest rice mill in the world, where the hulls are removed and the rice is polished*

we eat it. The brown covering is used for hog feed, and the hulls are used for fertilizer. Rice straw is fed to animals or it may be used in manufacturing paper and straw hats.

Enemies of rice. Birds have been enemies of rice fields from the earliest times. They seem to find particular pleasure in picking away the husks and eating the rice kernels. Fungous diseases are common. Wilt and smuts attack the plants, reducing the yields. Treatment of the seed might be advisable under certain conditions, but the selection of varieties that are not subject to diseases is probably the most effective practice.

QUESTIONS

1. Where is most rice produced?
2. Why is rice not raised in all warm parts of the United States?
3. How many kinds of rice are there?
4. What is the advantage of transplanting rice, as the Orientals have been doing for the last three thousand years?
5. How much rice is planted upon an acre?
6. What is the difficulty in harvesting rice with horse-drawn binders?

7. Why are tractors becoming the most important source of power in rice farming?

8. Why do we polish rice, while the Orientals do not?

9. What are two enemies of the rice crop?

PROJECT LESSON

Exercise I

Object. To learn the methods of rice germination.

Materials. Unhulled rice, wheat, glass tumblers, and soil.

Procedure. Put a few grains of rice in a glass of water after carefully removing the hulls. Plant a few grains in wet soil, and a few grains in dry soil. Repeat the same plantings using wheat. After two weeks note the results. (It may be noted that rice germinates readily under water and thrives in wet soil, while wheat dies or becomes sickly.)

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CHAPTER XXXIII

COTTON

History. Little is known as to the exact origin of cotton. Duggar states that "cotton is native of the tropical parts of both the Northern and Southern hemispheres." Cotton was grown in India many centuries before the Christian era, and up to the eighteenth century practically the entire world's supply was produced by that country. The cultivation of cotton spread from India to Egypt and other parts of northern Africa, and to Spain and Italy, where cotton is more or less extensively cultivated today.

Leading Countries in the Production of Cotton

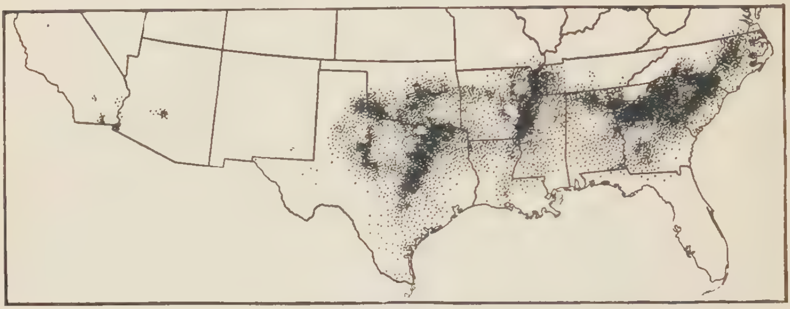
	Four-Year Average
United States	13,033,235 bales
India	3,585,000 bales
China	3,473,000 bales
Egypt	1,453,000 bales

Cotton was found growing by Columbus and Cortez on their first trips to America. The natives of the West Indies, Mexico, Peru, and Brazil were growing cotton and using it extensively for clothing when first visited by civilized man. The American Indians who inhabited what are now the cotton-growing states did not grow cotton at this early date.

Until 1793, when Eli Whitney invented the saw cotton gin, there was not enough cotton grown in the United States to furnish our people with clothing. The effect of this invention was greatly to stimulate production. In the period of one hundred and fifteen years after the invention of the cotton gin, production increased 600 per cent.

A crop of 1,000,000 bales was first grown in the United States in 1832. Three years before the Civil War the

production had reached 4,000,000 bales. For the year 1925 the production in the United States was 16,103,679 bales, with an estimated yield of 17,918,000 bales for the year 1926.



Courtesy United States Department of Agriculture, *Yearbook*, 1921

FIG. 282. *Cotton production in 1919*

Description of the cotton plant. The cotton plant originally was considered a perennial, but the cultivated cotton grown in the southern United States and in all other important cotton-producing countries is an annual. Under cultivation cotton is a much-branched shrublike plant ranging in height from two to six feet. The cotton plant possesses a cylindrical, erect, and gradually tapering central stem. The stems and branches are covered with tough greenish or reddish bark. Inside the bark the stem is composed of brittle white wood which decays readily when plowed into the soil.

The length and number of branches produced on a plant vary with the variety, soil, and the growing space. The branches are classified as "vegetative and fruiting." The vegetative branches are of two kinds: (1) the long branches that spring from the main stem and have no boll-stems directly attached, but possess sub-branches which bear bolls; (2) the sterile branches, whose only function is to increase the leaf area of the plant.

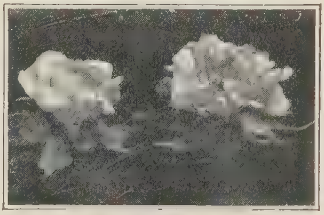
Fruiting branches are those that bear bolls directly attached. Both fruiting and vegetative branches may originate in the axil of the same leaf. The most productive plants are those that have a large number of fruiting branches.

Cotton leaves are quite variable in size, even on the same plant. They range from three to six inches in length, and from two to five inches in width.

The leaves of the American upland cotton are most commonly three lobed, the lobes are rather blunt, and the spaces between the lobes, shallow.

The leaves of the Sea Island and Peruvian cotton are also three lobed, but the lobes are much longer and more pointed.

Cotton flowers are large and rather conspicuous. Upland cotton plants have creamy white flowers when first open, which change to a reddish color on the second day. The flower has both pistil and stamens. The pollen grains produced by the stamens are heavy and waxy. Cross pollinization can take place only by means of insects that may carry the pollen from flower to flower.



Courtesy North Carolina Agricultural Experiment Station, Raleigh

FIG. 283. *Cotton flowers showing the "bracts," the leaf-like structure at the base of the flower; the calyx, presenting a cup-shaped appearance, as shown by flower on left; the corolla, which is made up of five petals; the stamens, which surround the pistil, as shown in flower on the right*

After fertilization takes place a leathery capsule called the boll is developed. In many other plants this would be called a seed pod. Cotton bolls are oval in shape, distinctly pointed at the apex, and vary in size from 1.5 to 2.5 inches in length and 1.2 to 1.7 inches in width. From the base of the boll to the apex, three to five divisions or valves are formed. The contents of each valve is called a lock.

Within each valve are six to ten oblong or angular seeds. The seed of upland cotton produces two kinds of fibers, the long fibers spoken of as lint and the short fibers, or fuzz, known as linters.

A cotton fiber may be defined as a unicellular hair which has been developed from the cuticle of the cotton seed. If a cotton fiber be examined carefully under a magnifying glass, it will be found to be broadest near or a little below the middle of its length, and it gradually tapers toward both the base and the tip. If the fiber is mature it will be somewhat flattened and irregularly twisted. It is claimed that the number of the twists varies from 300 to 500 to an inch. The degree of twisting is largely dependent on the stage of maturity, and is very important in determining the spinning qualities of the fiber. Immature fibers, on drying, form almost flat, structureless ribbons with very little twist and strength.

The length of cotton fiber varies with different varieties of cotton, and to a slight extent with the climate and soil conditions. According to Duggar the average length of fibers of the principal cottons are: Sea Island, 1.61 inches; Egyptian, 1.41 inches; American upland, 0.93 inch; American long staple, 1.3 inches.

The strength of the cotton fiber varies with its ripeness and fineness. The cotton fiber, in proportion to its size, is stronger than jute or flax, and three times as strong as wool. It is surpassed in strength by the fibers of hemp, manila hemp, and silk.

Botany of cotton. Cotton belongs to the order *Malvales* and the family *Malvaceae*, which includes many tropical plants. This family of plants is distinguished from the others of the order *Malvales* by the peculiar structure of the flowers, i.e., the stamens unite to form a tube round the pistil and the anthers are one celled.

Cotton belongs to the genus *Gossypium*. This genus includes some thirty to forty wild and cultivated species of cotton.

Important Cultivated Species of Cotton

Group I. American:

1. Gossypium hirsutum (upland cotton)
2. Gossypium barbadense (Sea Island cotton)
3. Gossypium peruvinianum (Peruvian cotton)

Group II. Asiatic:

1. Gossypium obtusifolium (Indian cotton)
2. Gossypium arboreum (Bengal cotton)

In the United States, the American upland cotton makes up about 99 per cent of the total crop. The plants of this species are erect, rather coarse, much branched, and short limbed. The leaves are generally three lobed, and the entire plant is clothed with an abundance of short hairs. The seed bolls are rather large, but not so pointed as in Sea Island. The seeds are large and covered with fuzz which gives them a greenish or grayish color. The lint or fiber adheres firmly to the seed, making it necessary to use a saw gin in removing them.

Sea Island cotton is grown only in a limited way on the coast and islands of South Carolina, Georgia, and Florida. The plants are tall, with slender branches. The leaves are three to five lobed, the seed bolls are small and pointed, with three and sometimes four locks or cells, the seeds are naked, and black in color. The lint is much longer than that of the upland cotton, measuring one and one-half to three inches in length.

Peruvian cotton originated in South America and is grown to some extent in southern Arizona and southeastern California. This cotton resembles the Sea Island cotton in habit of growth. The flowers are sulphur yellow in color.

The seeds are covered, or partly covered, with fuzz. The lint is longer than the American upland, but somewhat shorter than the Sea Island. The color of the lint or fiber is usually a light brownish shade.

Climate and soils for cotton. Cotton requires for its best development a sunny, long, warm growing season of six or seven months. During this time the rainfall must be evenly distributed. The temperature during the growing season should be uniform and relatively high. Sudden changes in temperature usually result in premature ripening. The average mean temperature of the Cotton Belt ranges from 71 to 74° F.

In the United States the Cotton Belt is located south of 37° latitude and east of the western border of Texas.

Cotton does well on most types of soil found in the Cotton Belt. However, the most productive soils are medium grades of loam, containing 25 to 30 per cent of clay and about 40 per cent silt. Such soils are porous, easily drained, and warm up early in the spring.

Culture of cotton. The cotton crop should be grown so as to cause the least loss of natural fertility from the soil and produce the highest net profit on the land and money invested.

Plowing for cotton should be fairly deep (5 inches), and the seed bed thoroughly prepared. The land is prepared for planting cotton either by the level or ridge method. The method used depends largely on the soil, the drainage, the season, and the lay of the land.

A ridge or bed is prepared for each row of cotton by turning several furrows with the plow around a lap furrow. Commercial fertilizer is usually applied as the field is being bedded for the row, or simply applied in furrows that are made in laying out the rows when level cultivation is practiced.

In order to make a profitable crop of cotton, high-grade commercial fertilizers are applied in large quantities throughout the cotton region east of the Mississippi River. In the southwestern part of the Cotton Belt, fertilizers are not so extensively used. The character of the fertilizer and the quantity applied varies with the fertility and type of soil, crop rotation, and boll weevil infestation.

Usually a fertilizer analyzing about 3–8–3 or 4–10–4 applied at the rate of 600 to 800 pounds per acre is recommended and used with profit.

Under boll-weevil conditions, it is the general practice to apply all the fertilizer before planting, except that on sandy

Courtesy North Carolina Agricultural Experiment Station, Raleigh

FIG. 284. *Listing and planting cotton. The fertilizer is applied in the row. A corn cultivator may be used to form a list or small ridge over the fertilizer. The cotton seed is planted in this ridge*

soils it is advisable to apply one-half the nitrogen as a side dressing to the row at the time of the first cultivation. Experiments at the North Carolina Agricultural Experiment Station indicate that nitrate of soda and acid phosphate are the best carriers for nitrogen and phosphorus under boll-weevil conditions.

Cotton is planted with a machine especially designed for the purpose. Only sound, recleaned seed should be planted. A large quantity of seed is drilled in the row, so as to assure a good stand of plants. The usual rate of seeding is 1 to

1½ bushels to the acre. After the young plants are about three inches high, they are usually spaced 8 to 10 or more inches apart, depending on the variety, soil, and distance between rows. This spacing is accomplished by chopping out with hand hoes. Recent experiments tend to show that thick stands will give better yields than when plants are spaced. When cotton is spaced thick, that is,

Courtesy North Carolina Agricultural Experiment Station, Raleigh

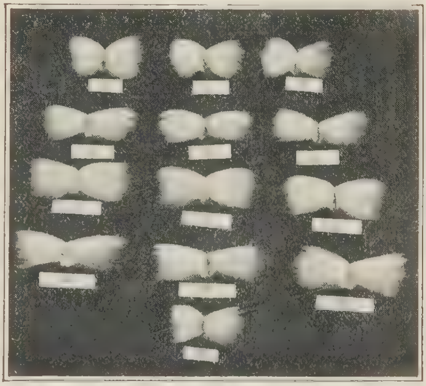
FIG. 285. *A field of early maturing cotton. Uniformity in plant growth and maturity is the result of pure-bred seed*

6 to 8 inches between hills, with one or two plants to the hill, the competition for light tends to make the plants grow upright without much spreading. The result is a main stem with a large number of short fruiting branches, rather than a main stem with a larger number of long vegetative branches. Close spacing stimulates early growth, which is important in avoiding boll-weevil damage.

Cotton should be thoroughly cultivated, this work being begun as soon as the crop is up. Weeds and grass should be destroyed as far as possible with the horse cultivator. While it is usually necessary to use the hand hoe for removing weeds during certain seasons and conditions, the high cost of this work makes it advisable to limit hand hoeing as much as possible.

The depth of cultivation depends on the weeds and grass to be destroyed, but as far as possible shallow cultivation should be practiced. Root pruning is as injurious to cotton as to many other cultivated crops. Cultivation of cotton should continue until the first cotton bolls mature.

Varieties of cotton. A careful survey of the varieties grown in the Cotton Belt would show that there are over four hundred named or so-called varieties of cotton. Often a variety will bear one or more names even in the same community. This state of affairs is very confusing and often misleading.



Courtesy North Carolina Agricultural Experiment Station, Raleigh

FIG. 286. *The lint of cotton seed combed out to show the variation in length and uniformity of the lint found in a single commercial variety. The length of staple varies from ½ to 1½ inches*

There are several different classifications for cotton varieties. All have their good points, but no one is entirely satisfactory. Cotton varieties are difficult to describe and identify, owing to constant mixing by cross fertilization and careless handling of the seed. Changes in the characteristics of varieties have been brought about by breeding, in order to evade the cotton boll weevil. Thus in many cases the original characteristics of a variety have been completely changed.

American upland cotton is naturally grouped into long-staple and short-staple cottons. Long-staple cotton includes all varieties that produce fiber 1⅛ inches in length or longer, and short-staple cotton includes varieties that produce lint less than 1⅛ inches in length. The greater part of the cotton grown in this country is classed as short staple.

The most profitable varieties in the Cotton Belt produce fiber measuring 1 to 1⅛ inches in length. Varieties of cotton may be further classified as to earliness, size of boll, character of plant, habits of growth, etc.

The most popular varieties in various sections of the Cotton Belt are constantly changing. This may be due to the activity of seedsmen, the result of an unfavorable season, invasion by the cotton boll weevil, or to a special demand on the market. A review of the results of variety tests conducted by the state agricultural experiment stations will show a large number of varieties under test at every station. The most commonly grown varieties of the Cotton Belt grouped as to length of staple are as follows:

Varieties producing less than 1⅛-inch staple:
Cleveland, Mexican, Rowden, Triumph, Lone Star, Cooks, King, and Trice

Varieties producing at least 1⅛-inch staple:
Webber, Express, Delfos, Acala, Dixie, Durango, Mead, and Delta Type

According to Collings the two most extensively grown varieties west of the Mississippi River are Mebane and Lone Star, and the leading variety east of the Mississippi, the Wannamaker-Cleveland.

Mixing of cotton varieties. Cotton varieties become mixed largely by mechanical means. No doubt the greatest amount of mixing occurs at public gins. The modern cotton gin is not constructed with an idea of saving pure seed. A very common practice among small cotton farmers is to gin a bale of cotton as soon as sufficient seed cotton is picked. This means that about thirty-five pounds of seed, which makes up a seed roll in the gin stand, is mixed through the seed of the following crop. Investigations by the United States Department of Agriculture show that more than 15 per cent of mixture in the seed occurs while the first bale

that follows cotton of another crop is being ginned. Considerable mixture may occur in the second, third, and even in the fourth bale, especially if the seed is not dropped in front of the gin stand but is allowed to be conveyed to the seed bin in the usual manner.

Varieties of cotton are often mixed by careless handling of the seed on the farm. Many farmers still practice the growing of more than one variety. In such cases there is always more or less mixing of the seed.

Cotton may become badly mixed by cross pollinization. Cross fertilization is brought about by bees and insects that visit the flowers. According to investigations, cotton plants may cross to the extent of 10 to 15 per cent. The extent of crossing varies with the activity of the insects and the distance between varieties or plants. Pure varieties of cotton are thus contaminated by neighboring fields of different varieties and by mixtures often found within the variety. Experimental results show that the only remedy for "running out" or degeneration in cotton varieties is to maintain the purity and quality of a variety by constant selection.

Cotton improvement. Pure-bred seed is essential to high yields and good quality of cotton lint. Experiments show that high-yielding strains selected and developed from standard varieties consistently outyield the common seed from which they came. A bale of cotton produced from common cotton seed will show considerable variation in quality and length of lint. Uniformity in cotton lint is essential in the process of spinning good cotton yarn and weaving high-grade cloth.

The cotton crop offers great possibilities for improvement. Very few high-yielding strains have been developed and maintained in the past. In choosing a variety of cotton to grow, the farmer considers uniformity in length and quality of cotton lint as important as the yield.

Cotton may be improved by the following methods: (1) increasing the yield of lint per plant, (2) developing a longer and more uniform lint, (3) developing a higher percentage of lint to the seed, (4) developing disease-resisting strains of cotton, and (5) developing earliness associated with high production.

Various methods of cotton improvement have been used by breeders and farmers. Early cotton breeders crossed many varieties with the hope of producing superior strains. At present breeders as well as farmers improve their cotton largely by some method of selection.

Courtesy North Carolina Agricultural Experiment Station, Raleigh

FIG. 287. *Field selection of desirable seed plants. Note the large number of open bolls, a desirable characteristic of cotton especially under boll weevil conditions*

Farmers who wish to develop high yield and quality in their cotton usually practice plant selection. After they have secured the best variety of cotton by test, they make field selections of the best seed plants, these plants are marked, and the seed cotton is picked separately from each plant. The farmer may multiply the seed in mass from all the plants selected, or he may further test out the seed from each individual plant in what is known as a plant-to-row test.

In some such way the farmer or plant breeder selects out and multiplies the most desirable strains from the better varieties of the cotton grown in a community.

A desirable cotton plant can be briefly described as having the following characteristics: (1) earliness—a large

number of bolls set early in the season; (2) good branching, typical of the variety; (3) short joints branched near the ground; (4) freedom from vegetative branches; (5) large number of bolls of good size; (6) foliage not too heavy; and (7) freedom from disease.

Harvesting seed cotton. Cotton lint is harvested almost entirely by hand. It does not seem probable that machines for picking cotton will ever be perfected so as to gather the seed cotton without including considerable trash. Cotton grades are established by the amount of trash in the lint, by its color, and by the way it has been ginned.

In order to produce the higher grades of cotton, great care must be taken when picking not to include leaves and stems with the cotton. When machines are used for picking cotton, the extra trash gathered usually lowers the value of cotton by two grades.

Picking is one of the largest items in the cost of production of cotton. The cost of hand-picking a bale of cotton lint is usually about $15. Machine picking reduces the cost to a dollar or less per bale. Machine pickers are now used on some of the large cotton plantations in the Southwest. No doubt their use will be more general in the future, and special machinery for removing the extra trash in machine-picked cotton may be designed and used at the time of ginning or as the lint is being prepared for spinning at the cotton mills.

Seed cotton is usually hauled to the gin as fast as it is picked. However, a more satisfactory method of handling seed cotton is to store it for several weeks so as to dry it out thoroughly. The advantages of storing seed cotton over ginning directly from the field are as follows: (1) a better grade of cotton is produced by the gin when the seed cotton is thoroughly dry; (2) the quality of the lint is improved by storing before ginning; (3) more uniform bales

of cotton are produced when a crop is ginned all at one time, rather than a bale at a time; (4) less time is lost by men and teams standing in line waiting their turn at the gin; (5) it affords an opportunity for saving pure cotton seed for planting the next season's crop. Much mixing of

Courtesy North Carolina Agricultural Experiment Station, Raleigh

FIG. 288. *Harvesting a plant-to-row test. Each row has been planted with the seed of a single plant that was selected in the general cotton field the previous season*

cotton seed occurs when only a bale or two of each crop or variety is ginned at a time.

Ginning. In brief, the process of ginning seed cotton is as follows: From the wagon the seed cotton is taken by an elevator and conveyed through chutes to the feeder of the cotton gin. The seed cotton then enters the "roll box," where it falls upon the ribs of the gin breast. Here the rapidly revolving circular saws, each one protruding between a pair of ribs, catch the lint and pull it from the seed. Brushes or an air-blast remove the lint from the saws and carry it into the lint flues. The seeds, being too large to pass between the ribs and the saws, fall down into a trough and are carried by means of a revolving screw conveyor to the seed pipe, then to the seed house or bin.

After the lint is removed by the gin, conveyors take it to the press, where it is baled. The standard flat or square bale weighs about 500 pounds and measures 54 inches long, 27 inches wide, and 45 inches thick. It is covered on two sides and on the ends with coarse bagging, and is tied with six iron bands.

Harmful insects. There are a number of insects which damage cotton: the cotton boll weevil, bollworm, red spider, cotton caterpillar, cotton stainer, cutworms, etc.

The most destructive cotton pest in this country is the *Mexican cotton boll weevil,* which annually takes a toll of tens of millions of dollars from the cotton industry.

The adult cotton boll weevils spend the winter months beneath trash left in the field, in dead grass along roads or fence rows, in partially opened cotton bolls, and under trash as found in wood lots. In fact, they are found in any place that affords protection.

The early summer broods feed upon the young growing plants. Later in the summer eggs are deposited in the cotton squares. The larvae feed upon the contents of the young cotton bolls, causing most of them to die and fall to the ground.

There are many helpful methods suggested for controlling the cotton boll weevil. Some of them are as follows: the use of poison applied in various ways, the growing of earlier cotton so as to escape the damage done by the larger numbers of weevils that develop later in the season, the destroying of all trash in the fields which affords protection during the winter months, and the use of readily available fertilizers that stimulate early maturity.

The standard dust-poison method recommended by the United States Department of Agriculture is possibly the one most dependable and profitable method of control. Calcium arsenate in powder form is dusted over the plants

when the air is calm and the leaves moist. A special machine designed to apply the poison by means of an air blast is now in general use.

Dusting should begin when infestation reaches the point at which 10 per cent of the squares show weevil punctures. At least three applications at intervals of four days apart should be made. Five pounds of calcium arsenate is used per acre for each application. According to tests, three to seven applications have been given cotton at an average cost of about $6.00 per acre. In thirty-one such tests the average gain for dusting has been 242 pounds of seed cotton to the acre over cotton that was not dusted.

Diseases of cotton. The diseases affecting cottón are cotton wilt, sore shin, cotton rust, bacterial blight, anthracnose, and root knot.

The *cotton wilt* usually causes a larger loss to cotton farmers than any other disease. This disease is widely distributed throughout the sandy soils from Virginia to Texas and is spreading from year to year to new localities.

In certain cases the yield has been reduced as much as 75 to 90 per cent. Cotton wilt may be suspected when the plants wilt and die for no apparent reason. If the stem of a freshly wilted plant is cut near the ground and found to be black or brown inside, this is strong evidence of the disease.

Diseases of cotton are controlled largely by indirect methods. Some of the recommended measures for control are as follows: the growing of disease-resistant strains, the planting of disease-free seed, rotating crops so as to rid the soil of the disease, and the use of certain fertilizers that stimulate rapid growth.

QUESTIONS

1. Tell what you can of the early history of cotton.

2. What effect had the invention of the saw cotton gin on the production of cotton in the United States?

3. Describe the cotton plant, flowers, seed, and lint.

4. Name the three cultivated species of American cotton. How could you identify one from another?

5. Describe the climate and soils best suited to cotton.

6. Describe the preparation of the soil and methods of planting cotton seed.

7. Discuss the use and method of applying commercial fertilizers for cotton.

8. Describe the spacing of cotton plants in the row. What effect has close spacing?

9. Tell what you can of the best methods of cultivating and hoeing cotton.

10. Name the commonly grown varieties of American upland cotton in the long-staple class; short-staple class. Name three most extensively grown varieties of cotton.

11. How do cotton varieties become mixed? What are the advantages of growing pure-bred cotton?

12. Name the ways the cotton crop may be improved.

13. Describe the harvesting and ginning of seed cotton.

14. Name the most destructive cotton insect. Name the most effective method of control.

15. Name the most destructive cotton disease. In general, how are diseases of cotton controlled?

PROJECT LESSON

At the time of the first picking of cotton, select 50 or more desirable cotton plants from the general crop, tag and number these plants. Harvest these seed plants separately. Determine the yield of seed cotton and the length and uniformity of lint for each plant. Discard the seed of the inferior plants. Mix the remaining seed and plant in a separate seed patch. Note the comparative uniformity and yield of plants in the seed patch and in the general crop.

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